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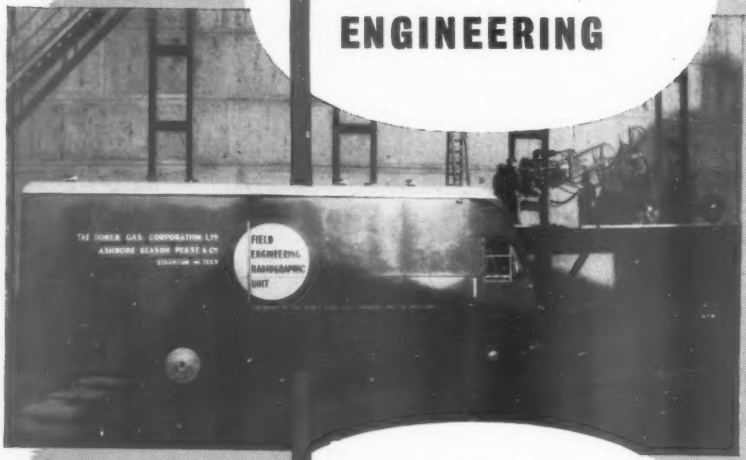

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PRINCIPAL CONTENTS

Technical : PAGE

Wax Models for Use in Investment Casting, by E. H. G. Sargent: This Paper covers the development of waxes from the earliest beginnings to present-day formulations. The chemistry of waxes and additives, physical properties, and faults of wax models are dealt with. Notes are also included on weld failure during investment, and details given of desirable properties and specific recommendations for waxes . . . 123

Scandinavian Foundry Review: Descriptions of two foundries in Denmark conclude this survey of the foundry industry in the three Scandinavian countries. Notes are appended of general interest to participants in the International Foundry Congress in Stockholm 133

Development in the Iron and Steel Industry: Extract from a report prepared by the Iron and Steel Board, followed by comment from the Council of Ironfoundry Associations 141

Features :

Leader: Development of Iron and Steel 121
Correspondence 122
Equipment and Supplies 132

Commercial :

Pig-iron and Steel Production . . . 146
Raw Material Markets 148
Current Prices of Iron, Steel and Non-ferrous Metals 150
Company News (Advert section) . . 27

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Development of Iron and Steel

Last Thursday, the Iron and Steel Board simultaneously published its Special Report 1957 and announced increased prices for its products. This, *inter alia*, means that foundries will have to pay 25s. a ton more for foundry pig-iron, and 49s. more for hematite. The only not-so-obvious comment that is called for is that for some jobs, light alloys will now be competitive. Of the 15 chapters of this important Report, only one is devoted to foundries.* Moreover, the outstanding feature relating to the future of the ironfounding industry, is refuted by a statement from the Council of Ironfoundry Associations. We would add that the biggest factor in ironfoundry statistics is the output of castings used for civil engineering; cast-iron pipes and tunnel segments, and the like, and variations in the production of these can play "ducks and drakes" with statistics.

The most interesting part of this section of the Report, is a table covering capital expenditure by sizable iron foundries, which shows that this year, for every hundred pounds spent under the heading of capital investment, £87 will be on production capacity and £13 on welfare, etc. The £13 (or £2,250,000 total) is mainly for the provision of bathing facilities for the employees. This is obviously a heavy burden to bear and though in the report for the year 1956, it is stated that, of five foundries closed down, in "four cases production had become uneconomic because of a fall in the demand for the products of the companies concerned," we have reason to believe some closures were due to the "burden" imposed. There is an interesting note to the effect that in addition to capital expenditure, about £10,000,000 a year was being spent on maintenance—the foundry must be quite a good market for oils, fats, and greases !

It would be unfair to the Special Report to confine attention to the small section dealing with iron and steel foundries, as the huge developments disclosed in the publication will have serious repercussions. The iron and steel industry is being scheduled to spend some £650,000,000 over the next five years, and by 1962 the production should attain 29,000,000 ingot tons. As it produced 20,660,000 tons in 1956 and bought 430,000 tons of ingot-mould equipment, the production of this commodity alone expanded in similar ratio would exceed the half-million mark. Obviously, such an impressive increase in steel production involves additional transport, new buildings, and much plant, all of which consume castings, both ferrous and non-ferrous. We would query the statement that the ironfounding industry could attain 4,500,000 tons per annum in 1962—the higher figure quoted—without any major expansion of its present capacity. This might be so if the load were evenly spread, but it will not be.

* See page 141 of this issue

Correspondence

WEST HAM SANDWICH COURSE

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—Speaking at a conference early in July, Lord Hailsham, Minister of Education, urged industrialists to revise apprentice schemes and recruitment policies to cope with the coming increased flow of school-leavers. Experience at West Ham College of Technology. indicates that a serious shortage of opportunities for young people already exists to an alarming extent, and that industry is making its plans all too slowly. It is extremely likely that many promising grammar-school leavers will have to be turned away this session, on account of the shortage of places in suitable firms.

The West Ham Sandwich course in chemical engineering was established with 12 students as a works-based scheme in 1957, and the first complete session is now ending. The scheme has proved attractive to both industry and student alike, carrying as it does, exemption from the associate-membership examinations of the Institution of Chemical Engineers. Wide publicity by press and radio has brought in many applications from the grammar schools, and it has been possible to place a sufficient number in industry to run two groups, staggered over the coming session, one course commencing in September, and the second in March, 1958. However, considerable resistance to a work-based scheme has been encountered, and present indications are that several applicants, who could easily be accommodated at the College, will have to be rejected from lack of sponsoring firms.

There appears to be no single reason for the apparent apathy on the part of industry. In some cases the new sandwich course conflicts with existing apprentice schemes; in others a works-based course is unacceptable; and yet, on every hand there is evidence of a grave shortage of chemical engineers for some years to come. The West Ham experience underlines the urgent need for industry to consider the Minister's recommendation.

E. A. RUDGE,
Principal

West Ham College of Technology,
London, E.15.

Iron and Steel Institute

The autumn general meeting of the Iron and Steel Institute, which is to be held on September 24, will consist of three technical sessions at the offices of the Institute at 4, Grosvenor Gardens, London, S.W.1, followed by an evening lecture, entitled the "Future Engineering Development of the Gas-cooled Nuclear Reactor," by Professor J. M. Kay, M.A., PH.D., at the Royal Institution, Albemarle Street, London, W.1. Members may bring guests to the meeting, no tickets being required for the technical sessions, but admission to the lecture at the Royal Institution will be by ticket only; these are available, free of charge, on request. Non-members wishing to attend the meeting should write to the secretary of the Institute, at the address given above, for a reply form.

Tenth Hatfield Memorial Lecture: At the invitation of the Council of the University of Sheffield, Professor P. Bastien, technical director, Et. Schneider et Société des Forges et Ateliers du Creusot, has agreed to deliver the tenth Hatfield memorial lecture, the subject of which will be the "Mechanism of the Formation of Banded Structures in Steel,"; it will be given at 6.30 p.m., November 28, in the Firth Hall of Sheffield University. Admission will be by ticket only, and applications should be made to the Registrar, The University, Sheffield, 10.

National Industrial Safety Week

"Guard Your Hands" is the slogan for this year's National Industrial Safety Week, which the Royal Society for the Prevention of Accidents is organizing for the week September 30 to October 5. The theme has been selected in view of the number of accidents which occur every year to persons engaged in handling goods. For example, in 1955 (the last year for which full records are available) no fewer than 44,613 persons were involved in handling accidents in factories alone, and the total number of reportable factory accidents from all causes was 163,332. It is pointed out by the Society that although all handling accidents do not involve injuries to the hands, there is no doubt that a large proportion of them do.

As with previous campaigns, the "Guard Your Hands" campaign will be directed mainly at managements, who during the week will be asked to encourage their employees to work safely—and particularly to look after their hands. Support for the campaign will also be given by 52 local industrial accident prevention groups, and in some cases co-operation will be forthcoming from local authorities and Chambers of Commerce.

Steel Castings for Nuclear Plant

A.P.V.-Paramount, Limited, of Crawley, Sussex, have been given a major contract for steel castings for nuclear-reactor plant, to be manufactured by the General Electric Company, Limited, (Atomic Energy Division). The steel castings are destined for the South of Scotland Electricity Board Power Station, the largest of the first three UK atomic-power stations to be built under commercial tender.

The G.E.C. has stated that: "The guide pans, through which control rods are lowered into the reactor core, demand steel castings of unusually high quality and dimensional accuracy and, in this connection, it is of particular interest to note that A.P.V.-Paramount, Limited, the most recent steel foundry to come into operation, has received this important contract in direct competition with some of the leading steelfounders in this country."

Forty Years Ago

In the August, 1917, issue of the FOUNDRY TRADE JOURNAL it was recorded that Professor J. O. Arnold had been appointed Dean of the new Faculty of Metallurgy at the University of Sheffield and that this was the first recorded instance of any university in the world creating a Faculty of Metallurgy. The monthly price list published quoted copper as selling at £125 and tin at £243. Durham or Welsh coke cost 45s. a ton delivered in London. This issue carried one of Professor Boswell's classical contributions "Some Geological Characters of Moulding Sands." Amongst new companies listed appeared the name of Guest and Chrimes, Limited, Rotherham.

Latest Foundry Statistics

An upward trend in ironfoundry employment is shown in a statement issued by the Council of Ironfoundry Associations. On April 27, it stood at 136,838 whilst on June 1 it had risen to 137,025. The gain though not large (187) reverses the recent downward trend. It is still 7,741 lower than a year ago.

Wax Models for Use in the Investment-casting Process

By E. H. G. Sargent, A. C. G. F. C.

In this paper, one of the first ever to be presented to founders on this subject, the Author covers the whole period from waxes in antiquity to present-day formulations. Early sections deal with dental-wax analogies, the chemistry of waxes and additives, and compounding of waxes. Next, desirable physical properties are carefully surveyed, covering such matters as mouldability and shrinkage; surface smoothness, resilience and impact and expansion. Faults of wax models are analysed into three main groups; here cracked and short-run wax patterns and those with surface ripples; entrapment of air and distortion of waxes on removal from the die are dealt with. Notes are included on weld failure during investment and concluding paragraphs cover desirable principles to follow and specific recommendations when choosing waxes.

Mr. E. H. G. Sargent is at present employed as chemist in charge of research and development in the general products section of Astor Boisselier & Lawrence, Limited, West Drayton, Middlesex. He received his technical training at the City Guilds of London College, Finsbury and gained the Associateship of the College in 1926. Over the past 20 years, he has been actively engaged in the development of plastic materials of all types.

The first material used in the investment-casting process was beeswax, the reason for its use being the very adequate one, that no other wax was available. Beeswax is, however, quite a satisfactory substance to use when only one model is to be made and when it is proposed to invest it as soon as it is produced. Fig. 1 shows how exactly details can be reproduced in beeswax, a fact also attested by the Death Masks in Westminster Abbey.

The process was used extensively in the Renaissance period and the description of it contained in Kragg's book[1], also reference to an abstract from a biography of Cellini[2], illustrate very fully the beauty of the articles produced in this way, and the process was never "lost" in the accepted sense of lost as forgotten, as Dunlop[3] points out. The revival in the field of dental metallurgy appears to date from 1897[4], but it became a more commonly accepted process after the publication of McTaggat's work in 1907[5].

Dental-inlay Waxes

The dental profession was not long in deciding that beeswax alone was not quite suitable for the process and in the 1930's, numerous references occurred as to suitable additives, such as paraffin wax, ceresine, rosin, gum damar and carnauba wax, substances which all find a use in modern investment-casting waxes. One of the few patents was Coleman's in 1938[6] and this formulation is number one in Table I[7].

The point with which these early investigators were concerned was shrinkage, as it is obvious that a loose dental-inlay would be most objectionable from several points of view, and methods for overcoming it were proposed by various investigators. Van Horne[8], Rice[9], and Dresseler[10], were all prominent in this field and in 1936, Armstrong[11] pointed out that injection under pressure minimized the total volume shrinkage of the wax pattern. In 1931[12] Taylor and his co-workers produced a specification for inlay waxes and included in the specification a list of flow properties which was actually a "compression-set" test. It consisted of subjecting a cylinder of wax 6.0-mm. high by 10.0-mm. dia. to a force of 2.0 kg. applied for a given time at set temperatures. The reduction in height which occurred was plotted against the various temperatures at which the test was made and the diagram so produced was considered to represent flow. The American Bureau of Standards produced a further specification in 1943[13] which referred to this test and also gave a method of measuring total volume contraction (mention will be made of this later). Fig. 2 shows that these materials do not give very good impressions of fine detail when used as casting waxes. As will be noticed, a modern investment-casting wax produces a much more definite outline.

TABLE I.—*Formulation of Typical Dental Waxes.*

	1.	2.	3.
Paraffin wax ..	60 per cent. of m.p. 50 deg. C.	35 per cent. of m.p. 70 deg. C.	30 per cent. of m.p. 49 deg. C.
Carnauba wax ..	25 per cent.	10 per cent.	30 per cent.
Ceresine	10 per cent.	—	20 per cent.
Beeswax	5 per cent.	55 per cent.	10 per cent.
Damar resin ..	—	—	10 per cent.

The industrial use of the investment-casting process appears to date from 1929[14], and the first patent dealing with the actual casting operation was granted to the Austinal Company in 1940[15]. Un-

* Paper presented to the Stratford on Avon conference of the European Investment Casters Association. The copyright is strictly reserved.

FIG. 1.—*Hercules and Cacus, an original wax model by Michelangelo. Before attempting a masterpiece, Michelangelo usually created his ideas in wax for study purposes, and then proceeded with the final work.*

fortunately, no mention of wax appears in the patent and there is none in the early literature.[16, 17, 18] Neiman[18] does give some formulations and from these, after considerable modifications, the latest types have evolved.

Chemistry of Investment-casting Wax Components

At a later stage in this Paper, the physical requirements of wax materials are enumerated and to them can be added, a high degree of heat-stability, very low ash-content, ready combustibility and absence of toxic or corrosive substances in the products of decomposition.[19, 30] Beeswax in itself has many of the desired properties, but it is too expensive and softens very considerably at temperatures around 25 to 30 deg. C. As mentioned, the dental profession compounded beeswax with other materials, such as vegetable waxes (which are much harder and have high softening points) and mineral waxes (which are considerably cheaper). Resins are also important constituents, and it is interesting to note that synthetic waxes are little used[14]. Synthetic resins are becoming increasingly important in this field. The need for providing for a plastic stage during setting requires that one major component shall have this property, and resins fill this rôle very well, so does beeswax itself and the petroleum waxes of the type known as micro-crystalline waxes. Surface hardness and dry "feel" are conferred by paraffin and/or vegetable waxes, and the other requirements are met by avoiding inclusion of pigments, soaps, and compounds containing chlorine or sulphur.

The need for inclusion of a plastic compound has led to some broad differences in the main types of waxes produced, as illustrated in Table II.

TABLE II.—*Characteristics of Investment-casting Waxes Used in Three Countries.*

	USA	Gt. Britain.	France.
Melting point, deg. C.	78 to 80	62 to 64	76 to 78
Hardness at 25 deg. C. (needle penetration I.P.T.) ..	9 to 10	3 to 4	6 to 8
Viscosity at 100 deg. C. (centipoises)	20	36	45
Co-efficiency of expansion 10 deg. above melting point, to 30 deg.	14	8	3
Acid value	3	9.5	4
Saponification value	28	36	35
Ash, per cent.	0.2	0.04	1.0

In general, it can be said that British practice favours paraffin wax and a fairly low content of vegetable wax, also a high resin content (30 to 50 per cent.), though there are, of course, several well-known exceptions to this generalization. Continental views appear to favour much more vegetable wax, and indeed some Continental products have no petroleum waxes in their composition. United States' formulations usually contain large amounts of micro-crystalline waxes, also a high percentage of vegetable wax and have a low resin content. The resins mainly used are wood rosin and its modifications, modified phenolic and alkyds. (These latter synthetic resins are condensed ring structures of low molecular weight). The long-chain plastics, best known by their trade names, such as nylon, polythene, perspex and polystyrene, appear in some of the patent literature [20, 21, 22] but their use is, it is thought, not very extensive. There are objections to the use of these compounds although they have the advantage of improving the very indifferent mechanical properties of the conventional materials. Their disadvantages are an enhancement of viscosity to such an extent that injection temperature and pressure have to be stepped up to the region used for injection moulding of plastics, and the plant and moulds required become correspondingly costly. Forced cooling of the mould becomes essential and the materials themselves lose the power of high fidelity of reproduction of fine detail, and low shrinkage, which, as Wood and Von Ludvic[23] have stressed, are the special advantages of wax over plastic patterns for this particular trade.

Recovery Value

A further point in the chemistry of these materials may be considered at this point—the properties of wax recovered from the investment before the latter is fired. It has been suggested[24] that wax

recovered in the solvent process for removing the wax from the investment can be re-used many times. This may well be true of material not heated above 120 deg. C., and in the absence of air, but a normal recovery method which involves filtering the molten wax usually necessitates heating in air somewhat above 120 deg. C.[18], and under these conditions, changes can and do occur. Wax mixtures, like almost all organic compounds, are susceptible to oxidation, although these are inert compounds with a long inhibition period, 36 hours or so in length. Preparation of the waxes from investment casting uses up quite a large portion of this period, and the time the material spends in the storage tank of the machine uses up quite a lot more, so by the time the material has been remelted and filtered it is most probable that oxidation will set in, and at a rapid rate, causing the material to soften, become sticky and dark in colour.

Formulation

One would like to have concluded this section with some actual formulations, but wax compounding involves quite a lot of "know-how" and unfortunately this knowledge is not readily protected by patents, although a few have been taken out. [20, 21, 22 and 25, 26, 27.] Consequently information as to the exact composition of useful compounds is not usually made public and it could be said of some formulae given in the literature that, in the words of the "film disclaimer," any resemblance between these and actual formulations is purely coincidental and not intended by the Author.

Physical Properties

An American authority, previously quoted, has listed 20 desirable physical properties for these materials[19], but a writer in the German periodical *Die Giesserei*[14] has condensed these to more modest limits. He says of the wax: "It must shrink evenly, have a smooth surface, be resilient enough to withstand vibration, strong enough to permit handling, have the lowest possible coefficient of expansion, and not distort when the temperature changes". The Author would add little to this except to suggest that the wax's change of state should be of the shortest duration compatible with complete filling of the mould, a point made in one of the early papers on this subject before the Institute of British Foundrymen[28].

The Author would like to enlarge on these points and give some of the methods used by manufacturers of these materials to see that the required standards are reached:—

Mouldability and Shrinkage

Some idea of mouldability can be obtained by making "slush" castings in the shape of very thin cups. Some of these are illustrated in Fig. 3. The cups will show flow lines on the surface, of greater or less intensity, and these give some indication of the way the material will behave in practice, although certain materials which can only be moulded in the plastic state and under fairly high pressures will not form a cup at all. Another point which can be evaluated by this test is the speed at which the material "sets-off," that is to say, the number of seconds after moulding before one can remove the cup. Shrinkage tests are also done on cups of this type. The test cups are allowed to stand for 24 hours and their dimensions checked, any departure from symmetry about a diameter and any tendency for distortion of the bottom of

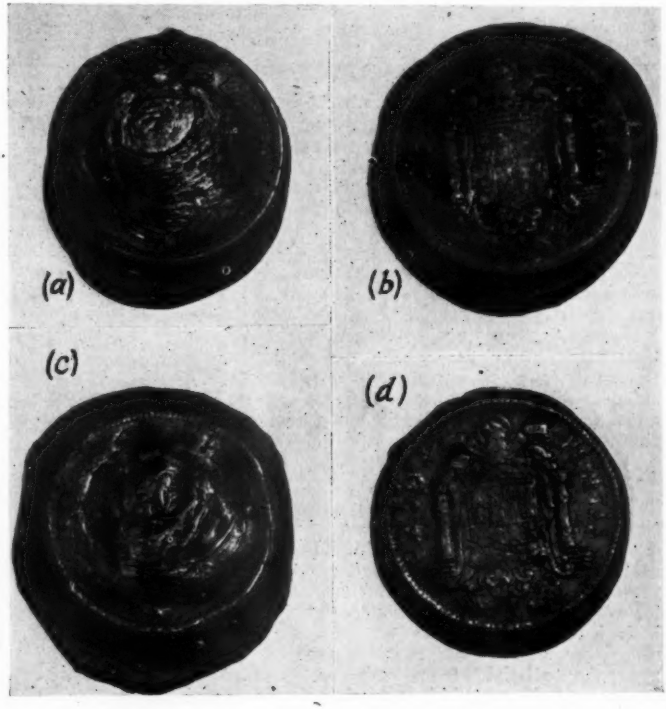

FIG. 2.—*Comparison between beeswax, dental and investment-casting waxes as regards ability to register fine detail:* (*a*) *and* (*c*) *are the obverse of a coin cast in dental waxes,* (*b*) *a coin cast in beeswax, and* (*d*) *cast in a British precision-casting wax.*

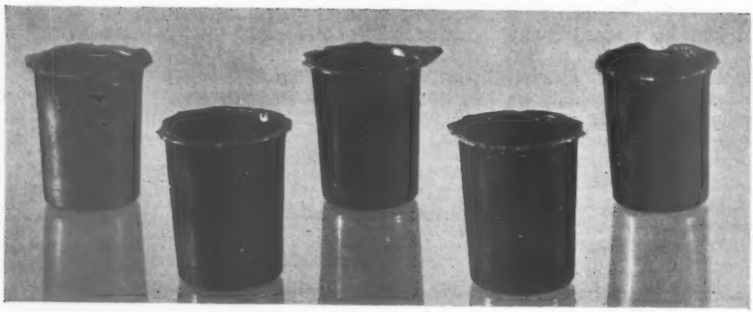

FIG. 3.—*"Slush-cast" cups of typical waxes; they are used for determining shrinkage and mouldability of various compositions.*

the cup can be seen. Some figures are given in Table III.

Smooth Surface

Here the problem is to provide a material which will "wet" the mould surface when hot, but which will not adhere to it when cold. Provision in the composition of an adequate amount of material having polar groups in its molecules is the best answer. Ester waxes are very suitable substances for this purpose.

Deformation

The ability of a moulding to withstand deformation, particularly when the temperatures tend to be above, say, 80 to 85 deg F., can, in the Author's opinion, be evaluated reasonably satisfactorily by making a thin bar of the material to be tested, allowing it to rest at one end at an inclination of 45 deg. to the vertical and allowing it to stand like that for some 24 hours. The bar is then placed against a straight edge and any deviation from normal can usually be seen quite readily.

TABLE III.—*Typical Dimensional Variation from Cup-moulding. Tests of Waxes.* (*All Dimensions in Inches.*)

	Top diameter.	Variation.	Bottom diameter.	Variation.	Height.	Variation.
Dimensions of the original cup	1.556	—	1.448	—	1.77	—
Moulding A	1.552	0.008	1.391	0.010	1.745	0.02
Moulding B	1.554	0.020	1.398	0.011	1.760	0.015
Moulding C	1.542	0.012	1.374	0.012	1.765	0.005

Wax (A) is a British material of very short setting-range; (B) is also a British material of short setting-range, and (C) is a U.S. material of long setting-range.

"Resilience"

It is thought the phenomena, which the writer referred to earlier[14], had in mind was the tenacity of the weld between a wax model and the "tree," which has to withstand quite an amount of vibration during investment. Wax materials have no resilience in the sense one uses the term when talking of a spring or of rubber and rubber-like polymers. Some idea of weld strength of waxes can be ascertained by bonding two bars of the material together under standard conditions and then loading one end of the bar whilst holding the other in a clamp. A weld which will withstand a static load of over 500 gm. per sq. cm. appears to be strong enough when such a material is actually invested.

Impact testing

Impact testing is best done by allowing a weight to fall from a known distance on a moulded disc of the wax material which is rigidly supported at the edge but allows the ball to drop through the centre when it has broken the material. About 24 specimens should be tested for impact and it is inadvisable to use the same specimen for more than about three trials in order to get the approximate height from which the ball should be dropped. Repeated blows weaken these materials considerably and a false impression can be obtained if the material is subjected to, say, 12 or 14 drops.

Co-efficient of Expansion

Fig. 4 shows variation of expansion of various types of waxes with temperature. The curves were obtained using the apparatus shown in Fig. 5, which is really self-explanatory. To obtain full readings over a convenient length of tube one should not have more than 5 gm. of wax in a 25 ml. flask; the total length of the measuring tube need not be more than 120 cm. As can be seen, the variations in expansion of the five waxes of Fig. 4 are quite considerable. The method described was used by a British firm who are prominent in the investment-casting field but it is not thought that a description of it has appeared in print before. A simpler, and probably a more informative procedure, is to make cup mouldings of the type already mentioned. The American Bureau of Standards' circular[13], previously mentioned, gives yet another method, but it is only suitable for waxes which are used when they are still plastic solids, and the very small size of the specimens chosen makes the method very inaccurate, because very small errors in measurement introduce large percentage errors into the results. The method is to force the plastic wax into a hole of approximately ¼-in. dia. at the top tapering towards the bottom. The mould is ½-in. deep. When the plug is cold it is pushed further into

the hole and the frustrum which protrudes is measured, and its volume divided by the total volume of the plug multiplied by 100 is considered as percentage volume of expansion.

Pomey[29] has analysed the position when liquid wax is forced into a mould, and points out that temperature, pressure and geometry of the moulding all influence the final result, adding that by increasing moulding pressure, the contraction could be halved in some cases. The Author has witnessed a test which confirmed the conclusion that total volume of contraction is not an important constant when one considers actual moulding practice. A model, roughly rhomboidal in shape, longer face 4 by 3 in. tapering to 4 by 2 in., the other side which is 2 by 2 in. and 3 by 2 in. approximately, the whole model being hollow and of wall thickness of about 0.1 in. was moulded from two different waxes, both of a type suitable for injection in the plastic state, having high setting points—some 80 deg. C.—but with a total volume of contraction in one case some 10 per cent., in the other less than 5 per cent. A measurement of the final dimensions showed that the wax with the lower volume of contraction was on the average giving a model about 0.001 in. shorter than the other on the longest dimensions, *i.e.* well within the tolerance limits.

Flow

Values for the flow properties of waxes, illustrated in Fig. 6 were obtained in a Ferranti concentric-cylinder viscometer of a modified Couette type, *i.e.*, one measures the force which opposes the rotation of the other cylinder and correlates to viscosity by means of calibration curves. A study of such curves will readily indicate the temperature to choose if it is desired to inject wax in the liquid or the plastic state, and also enables a wax to be chosen with a short or long transition period, when it can be injected. It is interesting to note the statement by Wood and Von Ludvic, occurring on page 82 of their book[23] that "an extended solidification range over about 22 deg. C. is desirable, so as to permit injection in the plastic state" a view also held by Geist and Kerr[30] who go so far as to speak of the possibility of injection of wax in the cold. These opinions are quite contrary to those expressed earlier in this paper on the desirability of a short injection-range. Possibly the reasons for these opposing views, in part, are due to the relative sizes of the models being considered. Most of the actual production models personally seen in England are small, and Tompkinson[31] has suggested that 8 in. is about the practical limit on length. The Author has no first-hand knowledge of US practice, but from the literature, it is concluded that much larger objects are frequently made in the United states: (Wood and Von Ludvic *loc. cit.*). Wilner describes 16-in. long aluminium propeller blades made on a large scale by investment casting[32]. There would be an advantage in using plastic waxes for large models as the possibility of making a short run would be minimized. For small objects, there is little doubt that a material with a short period of change of state gives better definition and allows of a very short moulding cycle.

Model Faults

Tedds[33] has analysed these very fully and his comments are of considerable interest. The principal faults can be summarized as follows:—

Short-run and Stress Cracks; Ripples on the Surface

Here it is thought the basic fault is the use of material at a temperature too low to allow the mould to fill without undue pressure being used, also these defects are sometimes observed if the mould is unusually cold, say at start of production. The cracks and ripples appear to be due to the fact that the material has commenced to set before

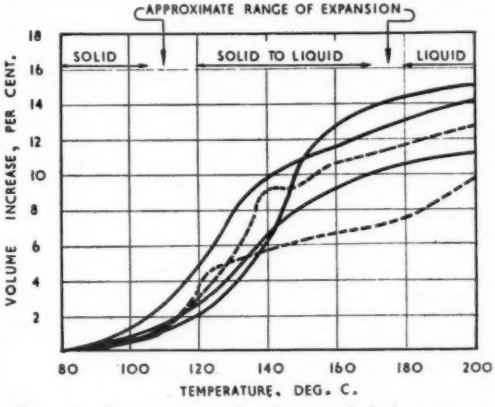

FIG. 4.—*Expansion of compounded investment-casting waxes. The broken lines show typical British waxes and solid lines waxes of American origin.*

reaching the mould boundary. As the material has but little cohesive strength at this stage, it is readily ruptured by the pressure of the liquid or plastic material which is still being forced into the mould. A short run will occur when the material is so viscous that sufficient material cannot enter into the mould before the injection period has terminated. Sometimes the geometry of the model is such that the flow is interrupted before the end of its run by having to flow at an abrupt angle to its previous path and in this case the cracks and the short run will often occur simultaneously.

Entrapped Air. This is sometimes caused by turbulent flow at the ingate (Tedds *loc. cit.*), also because the material is filling the mould too quickly to allow the air to escape before complete closing of the mould. Provision of extra vents remote from the ingate or the use of lower temperature and pressure are advised to correct this fault.

Distortion after removal from the Mould. Here the cause is frequently the presence of plastic or liquid wax in the model in such an amount that the

solid portion is pulled out of shape, as this material solidifies. Varying rates of cooling of thin and thick portions of the model also cause distortion. Also, of course, it may be that the wax itself is too plastic to withstand the temperature at which it is removed from he mould. Possibly Wood and Von Ludvic's (*loc. cit.*) suggestion that a wax which can be moulded at 71 deg. C. should be removed from the mould at 43 deg. C. is not a very sound one for waxes having a large content of material which is plastic at 37 deg. C. or below, and most US materials personally seen are of this type. Probably a temperature 25 deg. C. above the approximate solidification point, as shown on a flow curve, would provide a safety margin. For small models the safety margin can be less, particularly if they are fairly symmetrical in shape.

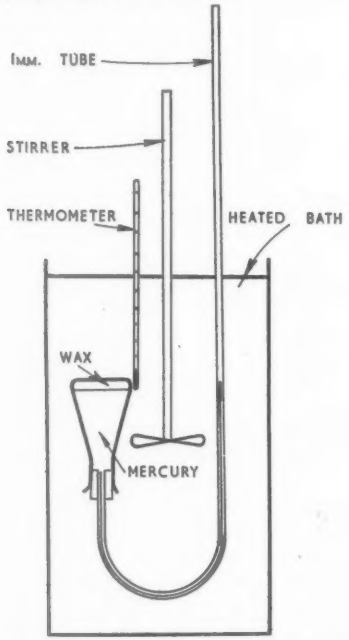

FIG. 5.—*Apparatus for determining the coefficient of volume expansion for investment-casting waxes.*

The use of chills is frequently advocated to minimize distortion. The idea is to reduce the total volume of wax which has to be cooled from the liquid to the solid state and also to some extent to equalize the rate of cooling of the thick and thin portions of the model by providing chills in the thicker sections.[23, 30] A point overlooked in some cases when using chills is that a chill made from a plastic material, such as poly-methyl methacrylate or polystyrene, is a distinct source of weakness in a model. There is no sort of bond between the wax and the plastic, consequently the division between these two is a point where cracks can readily occur. This is the same type of failure which one notices with ordinary plastics mouldings, where the majority of cracked components carry indications that the crack has started at or in the vicinity of a metal insert.

It is thought, therefore, that the best material to use for chills is a wax somewhat similar in general characteristics to the main body of the material but, preferably, having a lower melting-point, so that the chill and the body of the wax may be readily moulded together during injection.

Weld Failure during Investment. The wax is sometimes blamed for this failure; probably somewhat unfairly. Wood and Von Ludvic refer to the difficulties of getting a good joint between model to runner. The point to be stressed is that the moulder naturally desires a non-tacky wax, consequently the manufacturer endeavours to produce a material without this undesirable property. However, when one wishes to weld this to another piece of wax, it is necessary to heat it for long enough to develop sufficient tackiness to ensure a really strong bond and it is probable that failures which are stated to be due to insufficient weld strength of the wax are really due to the fact that the heating of the model was not sufficiently prolonged or not carried out at a sufficiently elevated temperature.

Other General Principles

From what has been said, it can be seen that the materials which have been discussed are essentially plastics with very poor mechanical properties, and probably quite a few failures to produce good patterns have been due to the fact that the user did not fully appreciate this point. It should be stressed that the general principles of preparing the wax patterns should follow the lines of injection moulding of plastics rather than casting of metals. It follows that mould design and moulding technique must be based on the practices of the plastics industry and not of the metal foundry.

Another point frequently overlooked is that the plastics industry makes use of many grades of moulding materials so as to suit the materials to the job, and this practice has a lot to recommend to the wax-pattern industry, because the growing diversity of models makes it impossible to produce a universal moulding material. It is true that time will be lost and material wasted in changing the grade used, but the preparation of wax patterns has a high labour charge in its "cost make-up" and a run of useless patterns, due to the use of unsuitable material, is likely to prove much more expensive than the cost of cleaning and refilling an injection machine.

Summary of Recommendations

Summarizing, it can be said that:—(1) The selection of patternmaking material for the investment-casting process cannot be governed solely by reference to only one or two factors. (2) A trial run on a new material is by far the most satisfactory method of assessing its potentialities.

(3) The best results are only obtained when optimum moulding conditions are chosen. The substitution of one wax for another without a study of the moulding properties nearly always leads to production trouble.

(4) When a sample of wax is requested from a supplier it is most helpful if some indication as to performance required could be given, *i.e.*, if for plastic or liquid injection, preferred limits of temperature and pressures to be used in the process, and so forth.

(5) The need for having available two or three standard grades of these materials must be appreciated if the most satisfactory results are to be obtained.

If these points are borne in mind, it is felt that the wax producer will be better able to supply the maker of patterns with the most satisfactory and trouble-free materials.

Acknowledgments

The Author's thanks are due to the directors of Astor Boisselier & Lawrence, Limited, for permission to publish this Paper, and his deep gratitude is extended to his colleagues who have helped in its preparation.

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DISCUSSION

MR. H. J. MEERKAMP VAN EMBDEN (Philips Research Laboratories, Holland), opening the discussion on Mr. Sargent's Paper, asked how far the different waxes were sensitive to the attack of alcohol contained in the investment liquids. With regard to the method of measuring the volume expansion in a glass vessel, as described in the paper, he said the results would surely depend on the type of glass used for the apparatus. The soft and hard glasses had different expansions.

MR. SARGENT replied that the effect of alcohol on pattern materials varied fairly considerably with their composition, but waxes which had a very high mineral-wax content were little attacked by alcohol. In most cases, the alcohol would "wet" the materials. If one made a model of wood rosin and beeswax it would more or less dissolve in alcohol.

Coming to the question concerning the effect of differences of expansion of glass apparatus, he said he was measuring the expansion of mercury in a manometer tube. One worked out the volume of mercury originally and subtracted that from the total volume after expansion, which gave the

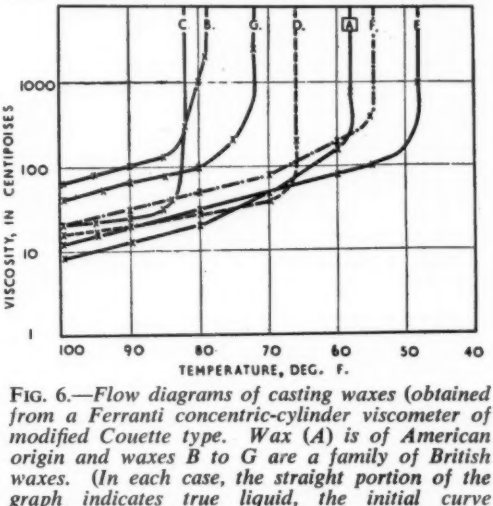


FIG. 6.—*Flow diagrams of casting waxes (obtained from a Ferranti concentric-cylinder viscometer of modified Couette type. Wax (A) is of American origin and waxes B to G are a family of British waxes. (In each case, the straight portion of the graph indicates true liquid, the initial curve indicates the setting or pasty state, and the vertical part the portion solidified.)*

volume of the expansion of the wax. Compensation was arranged for the volume change of the glass apparatus according to well-established formulae.

MR. N. E. TIDSWELL (W. J. Hooker, Limited) asked for the Author's comments on the desirability of using high- or low-pressure injection.

MR. SARGENT suggested that the answer rather depended on the size of the model that one was trying to make. If one were making very small pieces one could as a rule use wax at low pressure; it would set quickly and one would get quite a good result and a long "life" even from a soft die. On

the other hand, for a more complicated shape it was better to use a steel die and higher pressures, to ensure filling the mould completely, and without any chance of short-runs or flow lines.

MR. C. NIEUWENHUIS (N. V. Philips, Holland) asked for information on developments in water-soluble waxes.

MR. SARGENT said he had no personal experience of these. The only suitable materials he knew of were poly-glycols. Perhaps something could be done with gels such as pectin or alginates—but he had not had a chance to experiment on those lines.

Shortcomings of Waxes

MR. J. AHERNE-HERON (Trucast Limited) said wax manufacturers had not yet met with all the requirements mentioned by Mr. Sargent. For example, one of the requirements not yet taken into consideration was the total expansion of wax material from ambient temperature to the liquid state. Investment founders could inject wax models practically solid and cold, but these same waxes had to be melted out of a mould, and it was the total expansion and not the coefficient of expansion that was so important, as if excessive it could distort a mould cavity or even break the mould.

Most of the castings to be made embodied thick and thin sections and, to compensate for wax contraction, prefilled wax with polystyrene fillers had to be used. He asked if there was any possibility of overcoming the problem by other means, without the necessity of pumping in air or liquid so that the outside shell of wax could be obtained correctly and the interior filled later.

On the question of stiffness, he thought that normally the investment casters would prefer a broken wax pattern to one which was distorted. There was, therefore, a preference for the more brittle type of waxes as it was, of course, cheaper to produce wax models than to risk scrap among the final castings.

MR. SARGENT agreed that a perfect wax did not exist and was quite aware of the difficulty with regard to total expansion; but unfortunately that difficulty was brought about by the fact that a stiff and hard wax was required, not a soft one, and hardness usually went with high melting-point. It was unfortunate, but it was a fact.

He was not in favour of the loading of wax. In the plastics industry, every effort was made to avoid the injection of loaded materials, which gave rise to orientation or sedimentation and consequent failure. Much trouble arose when using a filler and one had a small gate and a narrow opening into the model itself, especially if the filled material had a good thermal-conductivity, for then it cooled too quickly.

With regard to the melting out of wax from moulds, sometimes he thought investment founders were a little too impatient. If they heated their moulds more slowly, allowing a fair time to bring the temperature up to the melting point of the wax, he did not think they would experience so much trouble with expansion as apparently they did.

Slow *v.* Rapid Mould Heating

MR. H. LISTER, (Fairey Aviation, Limited) taking up the point by Mr. Sargent that it was better to raise the mould temperature slowly so that the wax could be melted out successfully, said his experience was that the rapid attainment of heat was the better, so that the wax could be got out quickly, before the expansion spread right through the wax and possibly produced cracking of the mould.

MR. SARGENT replied that the point was very interesting, but much depended on the shape of the wax model being melted out. If the shape of the model varied from narrow to wide sections it was obviously best to get the material melted out out of the neck as quickly as possible, and expansion of the softer part of the wax behind would tend to push it out. But if the model were of more regular shape he considered it better to heat it slowly as a whole.

MR. A. DUNLOP (Foundry Services, Limited), referring to the hollow-wax method, where air was blown through the model, said the system generally worked very well. However, he warned founders that in some investment techniques where considerable pressure was built up by the investment around the wax, a hollow wax could become damaged.

MR. D. H. FARRIMOND (Joseph Lucas, Limited) remarked that in his firm's foundry the staff differed somewhat amongst themselves as to whether they should use slow or rapid melting-out of waxes. He mentioned one difficult section which had a double-headed core with a thin cavity in the centre, and said that they experienced serious trouble with scabbing when they melted out the wax slowly. By changing over to rapid melting-out, at a high temperature, the wax ran out before the heat had time to cause expansion of the total volume of the wax. In this way scabbing trouble was completely overcome. This was an example in favour of the rapid melting technique. He also drew attention to an article in the technical Press, in which the writer had advocated rapid wax melting as opposed to slow wax melting.

MR. SARGENT said he had read the article referred to, but it applied only to American-type waxes, which had a very long period of change on set and they flowed rather more readily than most of the British products. That was why the American wax became hot quickly; it was so soft that it ran out under its own weight. However, that would not necessarily be true of a wax with a very sharp setting range.

MR. J. AHERNE-HERON agreed with Mr. Sargent that the decision whether the melting out of the wax from the mould should be fast or slow depended on the assembly and the thickness and characteristics of the mould. Literature issued in connection with the "Glascast" process advocated putting the shells into a furnace at more

than 1,000 deg. C. in order to melt the wax out as quickly as possible, on the premise that the outer skin melted very quickly and vented itself, thus allowing room for subsequent expansion of the larger amounts of wax. This method also permitted the weaker "green" phase of the shell to be passed through very quickly. This type of fast heating, of course, could be adopted for shells or investment moulds only where the shape of the model and assembly permitted it; it could be appreciated that it was permissible only where there was progressive melting of the wax from the source of heat, so that no pressure pockets were formed.

Di-electric Heating?

MR. SARGENT said he was grateful for Mr. Heron's support and went on to ask if anyone had considered high-frequency heating being applied to melt out wax from investment moulds. The ceramic component, of course, was a good insulator and would not get very hot, whereas the wax mould would rapidly become very hot; as it had a lot of dipoles in it.

MR. J. AHERNE-HERON said that a lot of work had been done by the Philips concern on the di-electric melting of wax from moulds, but thought it had proved too expensive.

MR. J. MERMILLOD (Durox S.A., Switzerland) commented that di-electric heating could not be used when using a metal container for the mould. It would be necessary to remove the box in order to apply that method of heating.

Higher Production through Increased Safety

It is seldom realized that there are between 96 and 276 million accidents a year and that some 20 million man-days production are lost through reportable accidents alone. When these figures are considered it is obvious that the solution to many problems lies in the prevention of this tremendous loss of output which is over seven times greater than the total loss through industrial disputes, and the British Safety Council has launched a new service to help industry in this direction. The scheme takes the form of a safety programme of educational and technical material to make the workers safety conscious. Posters are the spearhead of the campaign which are followed up with leaflets dealing with subjects where they do not lend themselves to poster treatment or to supplement them with technical information. The leaflets are factual, helpful and can be read in a matter of a few minutes.

These are supported by mobile cinema units which can be used in canteens etc., or cinema vans for outdoor daylight shows. The film library contains over 700 films from all over the world and covers every aspect of health and safety in industry. Apart from these aids which will cut down the accidents and increase output, there is a panel of experts who will advise management on any matter concerning the safety, health and welfare of their staff. It is suggested that instead of waiting until there is a serious accident managers take advantage of this service now. The cost is nominal as the British Safety Council is an non-profit making organization.

Another Nuclear-powered Tanker Planned

Subsequent to the recent announcement of the creation of Hawker Siddeley John Brown Nuclear Construction, Limited, Babcock & Wilcox, Limited, has announced that in collaboration with Cammell Laird & Company, Limited, a study has been completed for a 65,000-ton nuclear-powered tanker using a reactor design developed from that at Calder Hall.

The agreement between the companies, a statement said, was not in any way exclusive and was to undertake feasibility studies and the development of designs in order to be able to offer complete nuclear-powered ships. In view of the high capital cost of a nuclear installation, the nearest approach at the present time to economic competition with conventional power was the large oil tanker, with its specialized service and high use factor.

American Experiences of Brittle Fracture of Crane Hooks

Brittle fractures* are usually associated with hard steel, but they are by no means so confined. Indeed, under certain conditions soft steel such as C1020 or C1040 is quite likely to fail in this way and many examples have been seen of brittle fractures in soft material. It is observed that there is a tendency on the part of engineers, where ductility is desired with strength a secondary consideration, to think such steel, on the basis of published mechanical properties, quite satisfactory. One example of such a failure was a large crane hook which showed a relatively brittle fracture. The material, C1020, had been normalized with a hardness of only 103 Brinell and yet a brittle fracture resulted when the hook was accidentally overloaded. Examination showed a characteristic crystalline fracture-surface, with no defects. Mechanical properties of this part were as follows:— Yield strength 31,000 lb. per sq. in.; tensile strength 60,000 lb. per sq. in.; per cent. elongation, 33.5; per cent. reduction in area, 59.6; Izod, 16 ft. lb., and hardness 103 Brinell. Part of the reasoning behind the use of soft materials for crane hooks is the desire for the hook to distort out of shape, instead of breaking under an overload. Instead of this ideal, brittle failures are the rule, due to the shape of the hook and the nature of the material.

* Abstracted from "Failures in Steelworks Plant." by Mr. J. V. Russell, *Iron and Steel Engineer*, April 1957.

Hadfields' Interim Report

An interim report, which the directors of Hadfields, Limited, hope to make a regular feature, states that activity has been well maintained since the report issued with the last annual accounts. The value of commercial sales is above that for the corresponding period of last year and this applies also to the Millspaugh subsidiary, which is making good progress including satisfactory results in Canada.

Possible adverse circumstances foreseen in the annual statement of the chairman, Lord Dudley Gordon, had arisen. There had been a temporary cessation of work as a result of the engineering dispute, causing heavy losses through the shutting down of all steelmaking. The recent increases in labour costs, coal, electricity, gas, and transport could only be recovered by increased output and efficiency. The interim dividend is 4 per cent. (same).

Equipment and Supplies

Conveyor-belt Guide Unit

British Wedge Wire Company, Limited, Academy Street, Warrington, announce that they have obtained the sole selling rights for the UK and Eire for the conveyor-belt guide unit known as the "Guidler." This device, which was described and illustrated in the April 15, 1954 issue of this JOURNAL, is of Norwegian origin and consists of a deep-grooved idler pulley designed for angle mounting at the edge of a belt conveyor. As the name suggests, it serves both in the normal manner to support the belt and also as a guide to correct any tendency towards lateral movement. An obvious application in foundries is to sand-conveyor belts.

Finishing Machine

Taylor Tools & Supplies, Limited, of Atlantic Street, Broadheath, Altrincham, have developed, and are now marketing in the UK, an entirely new machine for finishing large, flat surfaces by abrasion. The equipment is designed to operate quickly and efficiently on metals, plastics or wood, and is claimed to be economic, from the point of view of abrasive-belt life, even with less expensive types. The table of the machine (Fig. 1) is 36-in. sq., and polishing can be carried out over the entire width; lengths in excess of the table can be accommodated by moving the work-piece on the table. Clamping is facilitated either by electro-magnets as in Fig. 1, or by blocks.

The contact roll or pad is supported on a rigid bridge, and traverse is facilitated by air-hydraulic mechanisms, giving an infinitely variable range of feeding speeds. The table feed is automatic, and contact pressure can be varied to suit the finish requirements or the properties of the work-piece. Controls are claimed to be simple and safe in operation and conveniently placed, so that the operator has immediate control at all times. When required a new belt can be fixed in less than a minute.

FIG. 1.—*Finishing machine, designed for handling large, flat surfaces and marketed by Taylor Tools & Supplies, Limited, Altrincham, is claimed to be suitable for treating metal and wood to a width of* 36 *in.*

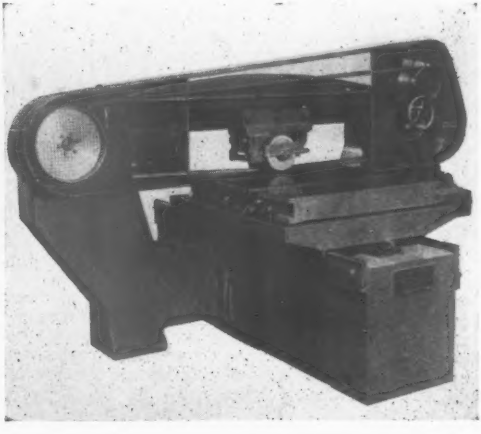


FIG. 2.—*Veriflex document-copying machine, introduced by Kodak, Limited, London, is claimed to be able to reproduce some* 240 *copies per hour.*

Document Copier

Kodak, Limited, Kingsway, London, W.C.2, have introduced a new lightweight document-copying machine (Fig. 2); designed to reproduce letters, reports, schedules, diagrams and other office stationery. Marketed under the trade name of "Veriflex," the equipment occupies little more space than a normal typewriter, but is capable of reproducing some six copies each of 40 documents per hour. The copier can be operated in normal office lighting by an inexperienced member of the staff, for it is claimed that no photographic or technical knowledge is required.

Spray Gun

A new type of spray gun (Model L.510) has been introduced by Alfred Bullows & Sons, Limited, Walsall, Staffs, and is claimed to be ideal for spraying unstable media, *i.e.*, those that will not tolerate agitation and violent changes of direction of flow. Its fluid passage is a straight tube normally made of stainless steel, but this can be changed for any specified material, which can be machined, so that the gun can be easily adapted for use with highly corrosive, abrasive and other difficult fluids. Simple in construction, the gun has a bronze body to which can be fitted the complete range of air and material nozzles for the Bullows L200, L500 and L600 spray guns. Ease of cleaning, and general maintenance have been carefully considered in its design, and it is claimed to be suitable for remote control.

AMBERSIL, the aerosol-packed silicone-spray mould lubricant, which was introduced last winter by Amber Oils, Limited, 11A, Albemarle Street, W.1, is now being used as a means of preventing spatter adhesion during welding operations.

Scandinavian Foundry Review

Final Section of a Special Survey conducted by the Editor

(*Continued from page* 107)

D. F. J.

Danish Hardware and Boiler-section Foundry

De Forenede Jernstoperier AS, usually referred to as D.F.J., last year celebrated its bicentenary as a foundry. Before that time, the Frederiksvaerk factory, which is some 25 miles north west of Copenhagen was an engineers' shop and before that, from 1728, an agate-crushing mill. The foundry was created by Major General Johan Frederik Classen, as a gun foundry and only recently one of its earliest pieces of armament has been discovered in India. In 1792, it was acquired by the Danish Government which in 1858 disposed of it by public auction to Mr. Anker Heegaard. This gentleman must have created the enamelling side of the business, as the range of kitchen ware was now sold all over the world and known as the "Anker line." The present company, D.F.J. Limited, acquired the business in 1928 and established the boiler section in 1941.

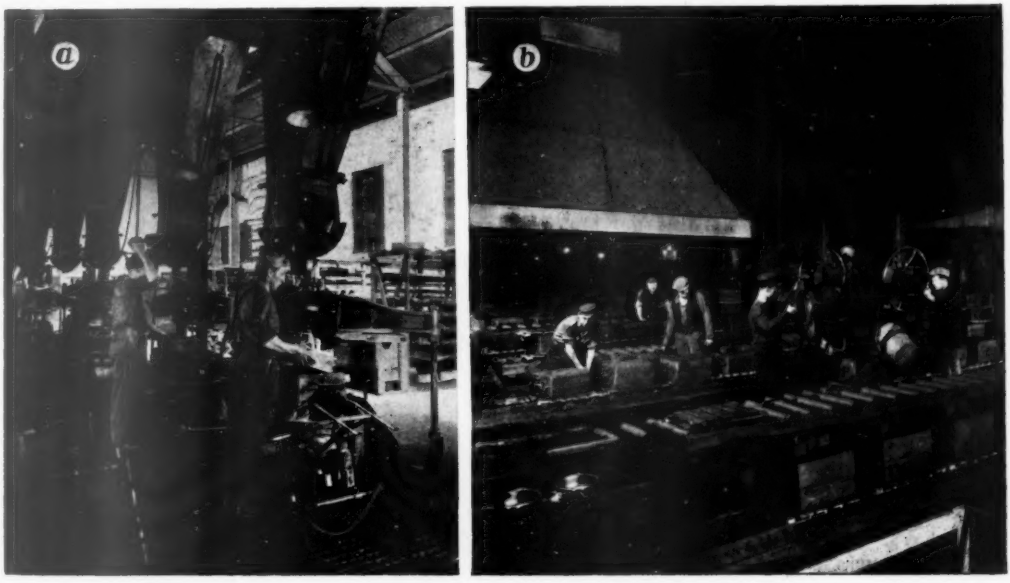
A pleasing feature of this foundry is that the walls of the entrance to the office are covered with photographs of the long-service employees of the concern—a permanent recognition of the contribution they have made to the prosperity of the company. The men work a 48-hr. week, which includes Saturday afternoon.

The works employs 550 workpeople and produces both grey-iron and malleable castings. There are 180 moulders, many working on the machines, 48 coremakers (all males), 43 fettlers, 15 patternmakers, 18 foremen and chargehands and 300 in other departments. With the other works owned by the company, the number on the payroll amounts to about 1,200.

Raw Materials

Raw materials, arriving either by ship or rail, are transferred to the foundry by lorry; the pig-iron utilized comes either from Sweden, Germany or Denmark, and coke, which carries between 10 and 12 per cent. ash, is of German origin. The main supply of sand is quarried locally and mixed with Danish bentonite and 5 per cent. coal-dust of either British or German origin. Core sand is made up from sea sand, linseed oil and dextrine—no core oils being bought. The frit for enamelling reaches

FIG. 1.—*Two views of the mechanized grey-iron foundry at the works of De Forenede Jernstoperier AS, Copenhagen. (a) Sand hoppers, situated over the line of moulding machines are fitted with rubber panels, which enable the operators to break up sticking sand. (b) Pouring section of the main bay showing the "home-made" pouring device being operated (centre) the conveyor systems and a trolley containing castings with wall thickness of only* $\frac{1}{16}$ *-in. (left foreground).*



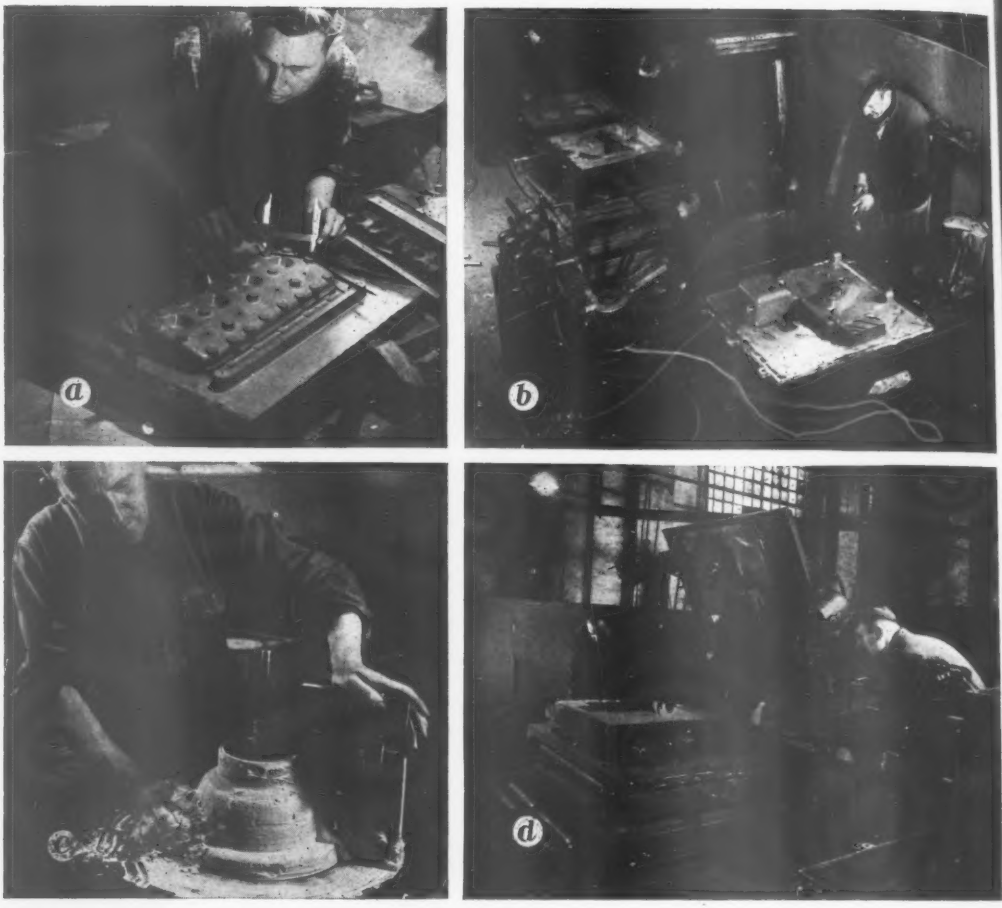


FIG. 2.—*Four views of patternmaking and moulding processes carried out in the foundries of De Forenede Jernstoperier AS. (a) Inspection of a metal pattern for a Ford-engine casting being carried out; (b) cleaning the metal pattern on a Tabor moulding machine; (c) producing a plaster of Paris pattern for a large grey-iron casting, and (d) inspecting a mould, produced on the Tabor machine, prior to despatch on the roller-conveyor system, to the casting area.*

the works from either Stewart and Gray, Limited; Blythe Colour Works, Limited, or the Dutch plant of Ferro Enamels, Limited.

Grey-iron Mechanized Foundry

Sand is prepared in an automatic plant supplied by Georg Fischer of Schaffhausen. Sand from the knock-out is taken on a band conveyor, and freed from tramp-iron by a magnetic separator, to feed a large storage-hopper. It is ploughed off from its base to enter a Simpson mixer, where new sand, coal-dust, water, etc., is added, and then taken up by a sand conveyor, where it feeds a scraper conveyor serving the moulding machines shown in Fig. 1*a*. Hoppers over the moulding machines are of special interest, as the panels above the moulders' heads carry a rubber section, which in case of sticking or lack of supply of sand, can be banged with either good effect or at least without damage.

The pouring device shown in Fig. 1*b* is home made and extremely effective. The pots shown in the wheeled container (left foreground Fig. 1*b*), by the knock-out, are only about $\frac{1}{16}$-in. thick, yet scrap is kept at the very minimum—one factor being that meticulous care is taken of the moulding-box fittings. The twenty moulders working in this department turn out some 5,000 tons a year. Another section of this foundry is devoted to snap-flask moulding, each moulder putting down 120 to

FIG. 3.—*Views of the enamelling shop attached to the foundries of the Danish hardware and boiler-section works near Copenhagen. (a) Shows a batch of goods being loaded into one of the electrically-heated enamelling stoves; the transverse loading system can be clearly seen, and (b) general view of the sheet-enamelling section (De Forenede Jernstoperier AS).*

FIG. 4.—*Four views of the boiler-section foundry department of De Forenede Jernstoperier AS: (a) Aerial view of the foundry, situated on the shores of one of the lakes; (b) view of the step-casting process, which provides economy in floor space; (c) view of the coreshop, serving the boiler-section foundry, showing the method employed for supporting the thin-sectioned cores during drying, and (d) coring-up moulds being carried out prior to casting.*

Scandinavian Foundry Review

150 moulds a day. Owing to shortage of space, the moulds are closely assembled over quite a large area, and the writer failed to notice how metal was poured into the centrally situated mould.

Another section of the foundry utilizes a Tabor jar/ram turnover machine (Fig. 2*b* and 2*d*) for the production of moulds for tractor diesel-engine components.

Melting Plant

Metal is melted in one of a pair of 10-ton per hour cupolas. Charges are made up in skips resting on a charging machine platform and pass up an incline automatically to discharge their contents into the cupola.

Patternshop

The patternshop is well equipped, turning out mainly metal and plaster of Paris patterns (Fig. 2*a* and *c*) but there is still much scope for wood patterns, as a quantity of jobbing work is still undertaken.

Coreshop

In the coreshop, the batch production of cores is practised using entirely male labour. The cores, as made, are loaded on to a shelved frame-work and transferred to the core-drying stoves by a fork-lift truck, This system also being used for their transference to the foundry.

MALLEABLE FOUNDRY

The feature of the malleable foundry, which produces the black-heart type, is the continuous, malleable annealing-ovens. A 32-hour cycle is followed with a closely-controlled temperature control. This system of one can in and one can out certainly makes for orderly production.

Fettling Shops

The fettling shops are of the usual character, but of the three shot-blast rooms, one is still using sand as an abrasive in the boiler-section foundry. However, every care is used to see that the dust is never breathed by the employees. In addition, there is a Wheelabrator plant and a rotary table on which are installed a series of auxiliary rotating tables. There are four tumbling barrels in the shop all of which are well dust-exhausted.

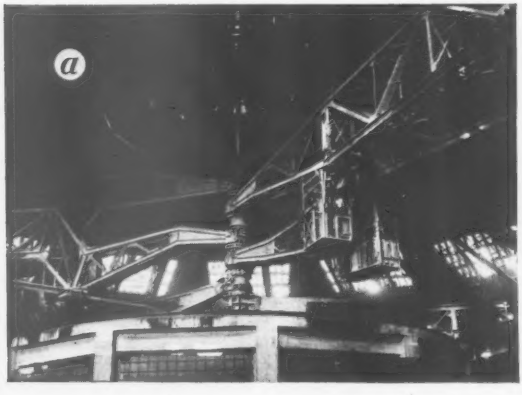
Enamelling Shops

Both cast-iron and sheet-steel work is being undertaken. As this firm has long been famous for its enamelled ware, perhaps the management prefer to retain batch production. They use electrically-heated ovens of Norwegian design, and mill their own frit—no lead-bearing enamels being used. Large quantities of acid-resisting goods are made daily, the wet process being used throughout, following the conventional two-coat process. For sheet enamelling, the firm has in general relied on material made in Shotton. Views of this department are shown in Figs. 3*a* and *b*.

Boiler-section Foundry

The boiler foundry is housed in a separate works shown in Fig. 4*a*, pleasantly situated on the edge of a lake. Both the coreboxes and carriers were extremely well made, as is necessary, for the cores are long and thin in section, as shown in Fig. 4*c*. Though heavier castings are also made, than is the case of the one described, much the same methods are used—automatic sand-preparation and distribution and roller conveyors for handling the moulds and returning the boxes. Figs. 4*b* and *d* show coring up the moulds and the system of step-casting utilized to effect an economy in floor space. There is an excellent shop for water-pressure testing the castings, their assembly, and re-testing

FIG. 5.—*Two views of the foundries of Burmeister & Wain, showing the circular layout of the premises: (a) The central office, of reinforced concrete, supports the pivot device, upon which rotate six cranes, serving the central section of the foundry, and (b) a view of the moulding and casting floor for grey-iron castings of medium weight, showing one of the cranes in operation.*



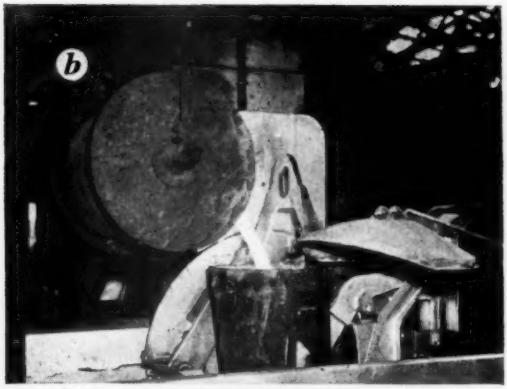


FIG. 6.—*Arrangements at Burmeister & Wain's for casting brake-shoes; (a) Two moulding machines, back to back, are supplied with sand from overhead hoppers; (b) metal being transferred from a drum-type holding ladle to the ladle of the brake-shoe pouring machine, and (c) close-up of the actual casting of a brake-shoe for the Danish railways.*

the assembled components. The output of this foundry is very high and the scrap rate consistently low.

Laboratory

There is a well-equipped laboratory available in a separate building, and is furnished with the usual mechanical-testing, chemical and micrographical departments. The last-named produces really high-grade photomicrographs and the chief metallurgist ascribes this to a period he spent at the British Cast Iron Research Association. Much work is undertaken on enamelling control and associated problems.

Amenities

The canteen is divided into two sections, for males and females, for the latter are employed in the light-machining and assembly sections of the electric and gas-cooker departments. The canteen does not provide hot meals but sells coffee and beer—few Norwegian workmen drink tea. A feature of the canteen to which British local Chambers of Commerce would object was the variety of goods which could be purchased.

The washing, changing and bathing facilities are of a high order and are used by all the men. Playing fields have been acquired for use by the employees.

Conclusions

In the absence of Mr. Bach, the foundry director, the writer was taken round the works by Mr. Hertz, the assistant director, and Mr. Vadstrup, the production engineer, and to them he very cordially acknowledges his sincere thanks for the help he received in the preparation of this article.

Burmeister & Wain

Scandinavia's Largest Foundry

With an annual output of 22,000 tons, the foundry of Burmeister & Wain's is claimed to be the largest ironfoundry in Scandinavia. Its second claim to fame is that it is the only circular foundry in the world. It is said that when it was constructed in 1922, the notion of this unique form grew in the designer's mind, because he bore the same name as that of the local circus. Whether that be true or not, the original design was both clever and competent. However, foundry progress during the last 35 years is such that original imposing lines have had to be modified, to take advantage of newer methods of materials handling. The engineers at Tegleholmen, a suburb of Copenhagen, have tackled these problems in a masterly fashion. For instance, the fettling shops now requiring machinery which did not exist in 1922 have been separated from the foundry. The original idea, however, of using a quay branching out from the canal for bringing in raw materials and taking away slag and used sand is now employed in transferring the castings across the canal, to the cleaning shops, furnished with a similar quay. The cleaned castings are similarly transferred by barge to the machine shops and ship-building yards. Another change was the creation of a circular railway around the foundry, on which run two jib cranes (Fig. 5*a*). These, furnished with

Scandinavian Foundry Review

grab buckets, can transfer sand through hoppers mounted on the foundry wall, direct to the sand-preparation plant, erected in the gallery of the circular building, or handle the scrap and pig-iron direct, on the cupola-charging floor.

The foundry, which is 300-ft. in diameter and 88 ft. high, together with the steel foundry, fettling and patternshops, employ about 600 people, of whom about 140 can be classified as skilled. In it, castings, ranging from 10 lb. to 30 tons are turned out daily and in Fig. 5*b* the section of the foundry devoted to the production of medium-sized castings is shown.

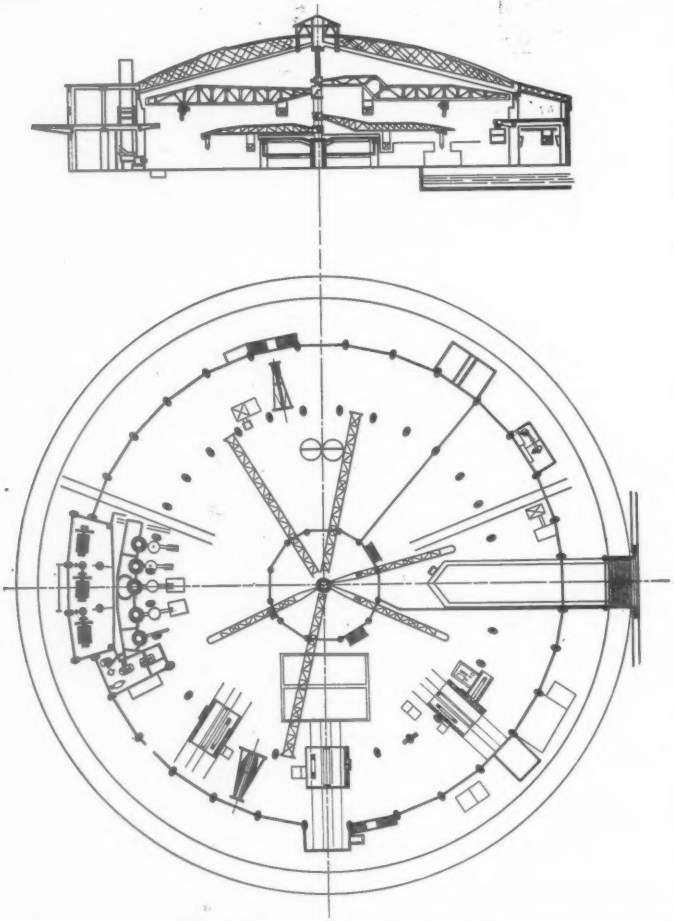


FIG. 7.—*Plan and side elevation of the foundries of Burmeister & Wain's at Tegleholmen. The circular design of the building is claimed to permit ease of handling, control and increased production per sq. ft. of floor space.*

A clever space-saving adaptation in this foundry is the system adapted for the making of brake shoes; produced on a pair of moulding machines shown in Fig. 6*a*. The moulds are then transferred to a power-driven mould conveyor, mounted on the edge of the gallery and making a complete circuit of the whole shops—about 900 ft. Fig. 6*b* shows the filling of the pouring machine from a transfer ladle and Fig. 6*c*, the former in operation.

Layout

The centre of the building is occupied by a two-storey reinforced concrete and steel structure of 60-ft. dia., which houses the office, store department, canteen and sanitary stations.

A steel mast, anchored solidly in concrete at the bottom and braced on all sides by the roof beams at the top, serves as a pivot for six electric travelling cranes, mounted one above the other so that if necessary any one crane may make a complete circuit (Fig. 5*a*). The main hoists on three cranes have a lifting capacity of 30 tons, with an auxiliary hoist of 3 tons. Each of the other three cranes have a lifting capacity of 10 tons.

These cranes serve the main bay of the foundry, 70 ft. in width, extending, as may be noted in Fig. 7, from the central building to the row of columns which supports the gallery and the outer runways for the three heavy cranes.

All large castings are moulded in the main bay, either in pits in the floor or in large flasks. Moulding is similar to that practised elsewhere in European foundries specializing in the manufacture of heavy machinery and engine castings. Many of the large core and mould parts are made on jolt machines, the largest machine having a lifting and jolting capacity of 18 tons—most of the moulding machines are operated with hydraulic pressure.

Cores and medium-weight castings are made in a circular section of the foundry, located between the row of columns and the wall of the building. Light castings are moulded and poured on a gallery above the outer floor and extending entirely around the interior of the building. Entrance to the gallery is by two wide stair-

ways on the exterior. The moulding space under the gallery is served by four electric travelling cranes, each with a lifting capacity of 6 tons.

Castings are cleaned on a section of the main floor set aside for the purpose in the vicinity of the canal. Slag from the cupolas and refuse of all kinds are loaded on barges and later dumped in the deep water of the harbour.

Metal is also melted in two 30-ton capacity basic-lined, oil-fired open-hearths, which are charged by means of a crane-suspended machine; a square, on the end of a counterbalanced arm, engages a socket in the charging boxes, which, when raised, can enter the furnace and be rotated.

Laboratory Services

The laboratory services are now under the supervision of Mr. Thegel, who, it will be remembered, gave a paper before the London International Conference. These laboratories are quite new, of modest dimension, excellently equipped and above all, the most artistically decorated of any the writer has so far encountered.

Excellent use has been made of the basement, such as, for example, the storage of oxygen bottles and its piping to usage points, for example, the Stohlein carbon and sulphur determination apparatus. Quite a series of elements—phosphorus, chromium and manganese are determined spectrographically.

Finally, the Author records his thanks to Mr. Jepherson the foundry manager and Mr. Thegel, both on the staff of Burmeister & Wain, for their kindly reception and the help they gave in the preparation of this description of their foundry.

Guidance to Congress Delegates

Foundrymen, or more especially their ladies, on a first visit to Stockholm need not be afraid to explore the city by themselves. Everyone speaks English and the official sketch map produced for the congress is excellent; indeed, its simplicity is its strength. The N.K. department store, well marked on the plan and the red neon-lit revolving sign of which seems to dominate the city's sky at night, should not be missed. The whole of its basement is devoted to Scandinavian products and there is a veritable riot of beautiful Swedish glass, pottery and flameproof ovenware, much of it sufficiently solid to withstand the ordinary risks of travel. An essentially Swedish toy for the children, which is to be seen everywhere for sale, is the Dalahäst, an orange-painted wooden horse traditionally coming from the Dalarna district around lake Siljan, beyond Borlange. Flower shops are everywhere so numerous in fact that " to say it with flowers " must surely be the third language of Sweden.

Language

A stiff mental exercise awaits those who are disposed to try to understand a little of the spoken language or to pronounce the place names. Words do not appear to be in the right place in the dictionary according to English standards; but *nil desperandum*, they may usually be found at the end of the letter section. Words beginning with the modified A (Ä) or A and O with a circle over (Å and Ô) come right at the end of the dictionary.

When travelling through the country one is impressed with the uniformity of colour of the paint used on all the houses and farm buildings. The dark red which is used exclusively is a traditional by-product of the Stora Kopparsberg mining concern and on each building this is relieved by narrow frameworks of white painted strips. But even so, here and there a small brighter red cabin will be spotted, perched a little distance away from the main farm building and looking absurdly like its little sister. These are huts for food and grain storage called *Lada* in Sweden and *Stabur* in Norway. The further north one goes, the more elaborate and picturesque do they become until in Norway some of them look like the original bathing huts at Brighton. They can be seen at their grandest in the Oslo Folk Museum.

Food

The deeper one travels into the countryside, the more evident becomes the self-service principle on which many of the hotels and restaurants work. Indeed, the central " cold table " at breakfast and lunch time has much to recommend it, for with at least twenty dishes to choose from it is good to be able to stand in silent contemplation for a few moments before " taking one's pick." The pleasures of the Scandinavian " *Smörgasbröd* " with its usual accompaniment of schnapps and beer is so well known as to need no elaboration, but it would be a kindness to warn all good trenchermen that in Sweden, as in other Scandinavian countries, the laws governing driving cars after having partaken of alcohol are excessively severe and most probably account for the vast numbers of taxis one sees about. These flourish like daisies on a lawn and this in a country where there is one private car for every ten of the population. Incidentally, in Stockholm there is also only one garage to every eight cars which explains the fantastic sight of an incredible number of cars parked in the streets every night.

Recent Wills

DODDS, WILLIAM, a former secretary of the Mercantile Dry Dock Company, Limited, Jarrow £4,343

MEACHER, W., a founder of the Westminster Engineering Company, Limited. London, N.W.10 ... ... £20,139

BROTHERTON, A. T., former director of the Brush Electrical Engineering Company, Limited ... £50,403

MORCOM, T. L., former managing director of Belliss & Morcom, Limited, engineers, of Birmingham ... £141,419

WRIGHT, J. W., joint managing director of Walker, Wright & Company, Limited, iron and steel merchants, etc., of Darnall, Sheffield £8,019

YOUNG, R. N., former chairman and managing director of Banks & Davis, Limited, stampers, non-ferrous founders, etc., of Birmingham, and a director of Leaderflush, Limited, Nottingham, Tipper Industries, Limited, Willenhall, and Nortons-Tividale, Limited, Tipton £25,294

MOCHRIE, W. G., managing director of Tyseley Metal Works, Limited, Birmingham, vice-president and former secretary of the London branch of the Institute of British Foundrymen, convener and deputy chairman of the Technical Committee of the British Bronze and Brass Ingot Manufacturers' Association £8,809

Personal

Mr. FRANCIS E. YOUNG has been appointed a director of Redler Industries, Limited.

Mr. H. G. BOULLEN has been appointed sales director of Lancashire Dynamo and Crypto, Limited.

Mr. S. A. A. KNOTT, the secretary of Charles Roberts and Company, Limited, has now been appointed a director of the company.

Mr. ALBERTONIE HERMAN BROEKSMA, Q.C., has been appointed vice-chairman of Guy Motors Africa (Pty.), Limited, an associate company of Guy Motors, Limited, Wolverhampton.

The English Steel Castings Corporation, Limited, announce that Mr. R. DUNN has been appointed steel foundry manager and Mr. J. MCCRACKEN has joined the sales staff as service engineer.

In its quarterly magazine (No. 31) the British Coal Utilisation Research Association announces that Mr. R. CHERADAME, the technical director of the *Centre d'Etudes et Recherches des Charbonnages de France*, will deliver the sixth BCURA Coal Science Lecture.

Mr. F. P. D. SCOTT did not seek re-election at the recent annual meeting of Morgan Crucible Company, Limited, and is no longer a director. Mr. A. W. EDWARD, who has been appointed a director of the company, is president of Morganite Inc., the associated company in the US.

Mr. VINCENT WATKINS has been appointed a director of Steel, Peech & Tozer, a branch of the United Steel Companies, Limited. Mr. Watkins joined the company in 1943 as mechanical maintenance superintendent, becoming maintenance manager in 1948. He has been chief engineer since 1953.

Mr. L. T. WAKEFORD, chairman of Entwisle & Gass, Limited, Atlas Foundry, Bolton, presented a cheque from the management to 77-year-old Mr. J. PARKINSON, a moulder, who has retired after 50 years' service. Workmates, who gave Mr. Parkinson a fireside chair, also attended the presentation ceremony on July 23.

Mr. W. R. BLACK, J.P., has been appointed chairman of the National Research Development Corporation in succession to the late chairman, Sir Alan Saunders, who died in February. Mr. Black is managing director of Associated Commercial Vehicles, Limited, and has for many years played a prominent part in the motor industry.

Mr. J. W. BERRY has been appointed deputy managing director of Birmid Industries, Limited. Mr. W. J. SULLY, joint managing director of Sterling Metals, Limited, and Mr. W. C. JORDAN, deputy managing director of Birmetals, have been appointed directors. Mr. A. E. PEARCE and Mr. H. GOODWIN retired from the board on July 31.

Mr. EDWARD E. PARKER has been appointed general manager of Cameron Iron Works, Limited, Leeds. Mr. Parker, an American, who has been associated with the company since 1941, has spent much of his time with Cameron's in America. He has been in England since 1951, and has occupied the post of factory manager for Cameron's for the last two years.

The advertising department of the chemicals division of Newton, Chambers & Company, Limited, Thorncliffe, near Sheffield, has been reorganized to enable it to give to the engineering and excavator divisions a service in formulating and implementing their advertising programmes. The chemicals division advertising department has been strengthened by the appointment of Mr. J. A. BURCKHARDT as assistant advertising manager to Mr. Forsyth.

At the recent meeting of the Council of the Aluminium Development Association, the following changes in the membership of the Council and of the executive committee of the Association were announced: On the Council, Mr. S. E. CLOTWORTHY, managing director of Northern Aluminium Company, Limited, has succeeded Mr. W. FRASER BRUCE as the representative of that company. It will be recalled that Mr. Fraser Bruce recently became president of the Aluminium Company of Canada and left Britain in April to take up this appointment. Mr. B. L. PAGE (a director of John Dale, Limited) has succeeded Mr. J. F. PAIGE (managing director of William Mills, Limited, until his recent retirement) as the representative of the aluminium founders organization, LMFA Development, Limited. The Council appointed to the executive committee Mr. R. T. RAVEN (works director of Birmetals, Limited) as the representative of Birmid Industries, Limited, in place of Mr. HAROLD GOODWIN who has retired; also Mr. DESMOND JAMES (T.I. Aluminium, Limited) in place of Mr. W. H. BOWMAN.

Obituary

Mr. FRANCIS NORMAN PICKETT, engineer, inventor, and financier, has died at the age of 72. Between the wars he served as chairman of the Wellman Smith Owen Engineering Corporation, Limited, and was concerned in manganese mining in South Africa.

Mr. WILFRED MARSH GILLOTT, chairman of Marple & Gillott, Limited, iron and steel merchants, Stevenson Road, Sheffield, chairman of the Burton Constructional Engineering Company, Limited, and a director of Derbyshire Carriage & Wagon Company, Limited, has died at the age of 79.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

AUSTRALIA, October 17—Blast-furnace instruments for the Western Australia Government Tender Board. (ESB/17053/57.)

BURMA, August 12—Hydraulic jacks for the Purchase Board, Rangoon. (ESB/18002/57.)

GREECE, August 9—Road rollers. (ESB/17997/57.)

GERMANY, USA Air Force procurement programme require a comprehensive range of aircraft components, accessories and military equipment. (ESB/15824/57.)

SOUTH AFRICA, August 7—Sand-mixing machinery. (ESB/17268/57.)

Board Changes

ARTHUR BALFOUR & COMPANY, LIMITED—Mr. C. Carnell has resigned from the board.

WILLIAM JACKS & COMPANY, LIMITED—Mr. H. F. Clements has been appointed a director.

BUTTERLEY COMPANY, LIMITED—Mr. R. Hermon has agreed to join the board and has accepted the position of joint managing director.

PEGLERS, LIMITED—Mr. James M. Harrison has been appointed vice-chairman and Mr. Cyril Osborne has been appointed to the board.

BRITISH OXYGEN CHEMICALS, LIMITED—Mr. Leslie G. D. Sheldrake has been appointed works director and Mr. J. M. Williams sales director.

Development in the Iron and Steel Industry

Iron and Steel Board Special Report (and CFA Comment)

A report just published by the Iron and Steel Board carries one chapter dealing with "Developments at Foundries and Forges." In part it says:

This report has dealt primarily with the expansion of steelworks and the development of iron for steelmaking, although reference has been made to the production of foundry pig-iron. This chapter deals briefly with developments at iron foundries and steel foundries, where the Board have only limited responsibility for development, and with developments at heavy forges. The drop forging industry is outside the iron and steel industry as defined by the Act and it is not discussed.

Iron Foundries

For many years, the consumption of iron castings, as a proportion by weight of the total national consumption of all iron and steel products, has tended to decrease. Other materials, such as steel, light metals, plastics, asbestos cement and reinforced concrete have been substituted. Over the last ten years the engineering industry has gradually been using a lower tonnage of iron castings in relation to the output of engineering goods; the relative decrease has been at a rate of about 3½ per cent. a year. This trend may even be accelerated as steel becomes more freely obtainable, for past experience has shown that the periods of stronger demand for iron castings have coincided with the periods when steel has been most scarce. This decrease does not mean that the ironfoundry industry is declining, but there is a change of emphasis from common heavy castings to more specialized work. Greater use is being made of certain improved forms of cast iron; also the ordinary grey-iron casting retains its advantage in many fields because it is relatively cheap, its physical characteristics are the best for certain applications, and it has good resistance to corrosion. Nevertheless in contrast to the calculated increase of 45 per cent. by weight in the home and export requirements of steel between 1954 and 1962, an increase of up to 15 per cent. is suggested for iron castings. The demand for castings, so far as the Board can judge, is likely to be between 4,000,000 and 4,500,000 tons in 1962. The industry could certainly attain this output without any major expansion of its present capacity.

Iron foundries are outside the Board's specific duties on development, and development schemes are not submitted for the Board's consent. The Board do, however, have the same general responsibility for promoting the efficient, economic and adequate supply of iron castings as of steel products. The Board have recently conducted a review of capital expenditure at iron foundries. The returns cover expenditure during the last three years and the estimates of expenditure in the current year in respect of: (*a*) the improvement of efficiency or expansion of output, and (*b*) welfare or other amenities not directly contributing to production, including expenditure to comply with the Iron and Steel Foundries Regulations of the Clean Air Act.

The result of the review is set out in Table I. The smaller foundries were excluded. The replies to the Board's inquiry cover companies making about 70 per cent. of all iron castings.

TABLE I.—*Capital Expenditure at Iron Foundries.**

	On productive capacity (£ million).	On welfare, etc. (£ million).
1954	5⅜	⅜
1955	6¼	½
1956	9½	1¼
1957 (estimate) ..	14	2¼

* This expenditure includes *all* expenditure in the classes shown, including development schemes costing less than £100,000 which are excluded from the estimates of capital expenditure at iron and steel works. In addition to the capital expenditure, about £10,000,000 a year was spent by these companies on repair and maintenance.

The manufacture of foundry plant does not in the main compete with steelworks plant for technical staff and engineering resources, and the two industries can each be developed without detriment to the other.

Steel Foundries

No large development of the steel-castings industry is expected and, except in the case of the largest castings, present capacity appears to be adequate to meet the foreseeable demand. Reference has been made to the difficulty that might be found by the makers of rolling mills in obtaining the very heavy castings for mill housings. There should unquestionably be more capacity to make castings of this nature. Two development schemes are at present in hand which go some way to provide it, although neither will be in production much before 1960. The Board have approved a proposal by English Steel Corporation, Limited, for a new melting shop in Sheffield, which would be designed to provide steel for really large castings and forgings. The Board have also approved a scheme for a new melting shop at William Beardmore and Company, Limited, Glasgow, in part for similar purposes.

CFA COMMENT

While the report states in its comments on iron foundries that the ironfounding industry is not declining, the Council of Ironfoundry Associations considers that the phrasing used might convey the opposite impression, and have, therefore, issued a statement containing the following points:—

(1) Iron castings production has increased from approximately 2,500,000 tons in 1946 to 3,900,000 tons in 1956—an increase of the order of 56 per cent.

(2) Comparisons based on weight alone, although statistically convenient, can be misleading. Better foundry techniques, casting designs, and metallurgical control have resulted in reducing the weight required for a casting for a specific job. The

Iron and Steel Industry Report

Council does not believe that the number of castings supplied to the engineering trades has diminished at all and indeed has probably increased.

(3) The statement that "this trend may even be accelerated," that is, the trend away from iron castings, is open to doubt. Owing to the fact that the statistics used for deducing this trend are based purely on weight, it seems improbable that any trend can be accurately deduced. In any case, production of iron castings for the engineering industry, when compared with the statistics of output of that industry, indicate that the relative use of iron castings, by weight, in 1956 was 2 or 3 per cent. greater than in 1955.

(4) It is implied that the iron casting and steel fabrication are interchangeable according to the prevailing supply position. This is not so. Both forms of construction and both types of material have their specific roles to play.

The whole tenor of the Board's comments is such that an impression is gained that the ironfounding industry is barely maintaining its present position. The Council is glad to say, and hopes that the comments made above show, that the ironfounding industry is in fact thriving.

Woodall Duckham Offers to Buy United Fireclay

An offer has been received from the Woodall-Duckham Construction Company, Limited, to purchase the 1,240,000 ordinary shares of 5s. each of United Fireclay Products, Limited. The offer is made on the basis of an exchange of shares in the proportion of two ordinary shares of 5s. each in Woodall-Duckham for every nine, ex the proposed dividend of 8 per cent. for 1956.

This offer is conditional upon its being accepted by the holders of not less than 90 per cent. of the shares by August 12, 1957, or such later date as Woodall-Duckham may decide. If the offer becomes unconditional, Woodall-Duckham intends to make available to the company about £250,000 to enable an expansion of its works and facilities.

The directors of United Fireclay Products intend to accept the offer in respect of their own holdings and strongly recommend all other holders to do likewise.

Objection to Proposed Durham Steelworks

Objection to the plans of the South Durham Steel & Iron Company, Limited, to build a large new steelworks at Greatham has been made by Billingham-on-Tees Urban Council (Co. Durham). The Council maintains that the works would increase atmospheric pollution and, although recognizing the need for industrial expansion, considers the proposal bad planning.

The South Durham Steel & Iron Company has stated that there would be no coal-firing, ore-handling, or sintering plant at the proposed works, and that the effluent would be negligible. The operation of the works would not provide grounds for complaint, and unsold slag would be dumped in the sea.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s. 6d.)

774,443. Electric Steel Foundry Company, 2141, North West 25th Avenue, Portland, Oregon, USA.

Mould wash for application to the walls of a foundry mould for coating them. It consists principally of a finely-divided refractory such as zircon or silica flour, water, calcium hydroxide and amorphous silicon dioxide (up to 2 per cent. of the total weight). The process claims to result in a casting with an outer surface free of pinholes, laps or cold shuts, whilst at the same time having a smooth surface and a sound casting throughout.

775,150. Societe d'Inventions Aeronautiques et Mecaniques (SIAM), 1 Route des Alpes, Fribourg, Switzerland.

Alloys of magnesium, zinc and rare earths which are free from manganese, having the following composition: zinc 5 to 7, rare earths 0.5 to 2, beryllium 0.008 to 0.012, silica not more than 0.15, aluminium 0.4 to 0.6 per cent. The remainder is magnesium. The rare earths employed have the following composition: lanthanum 2.5 to 3.5, neodymium 40 to 65, praseodymium 8 to 12, samarium 0.5 and cerium 2 to 10 (compare with Patent No. 768,276).

775,318. Metro-Cutanit, Limited, Grappenhall, Warrington, Lancs.

A hard-metal alloy, the main constituent of which (comprising at least 50 per cent.) is titanium boride or zirconium boride, or both. The remainder amounts to at least 5.2 per cent., and contains 0.5 to 10.6 boron, and 1.17 to 90 per cent. chromium with additions of one or more metals of the iron group. 40 per cent. of the main constituent could comprise one or more of the carbides of the metals, tungsten, tantalum, niobium, vanadium, chromium, molybdenum, zirconium, and titanium.

775,438. Stewarts and Lloyds, Limited, 41, Oswald Street, Glasgow, C:1, Scotland.

Improvements in methods of strengthening an ingot mould of the kind having a wide-open end and a narrow upper-end in which there is an opening which is usually restricted. The object of the invention is to prevent the cracking of the mould due to thermal shock and mechanical handling.

775,496. Glow-Worm Boilers, Limited, Derwent Foundry, Milford, near Derby.

A method of confirming a screw-threaded hole in a casting by locating a socket in the mould and inserting a member carrying a sand-core into the socket, the sand-core being shaped to form the screw-threaded hole in the casting operation.

775,499. Foundry Services, Limited, Long Acre, Nechells, Birmingham, 7.

The invention concerns the production of large, or intricate, moulds and cores, and is more particularly concerned with the already known processes of incorporating a silica gel such as waterglass in the sand used for forming the mould or core. After the mould is formed it is subjected to the action of CO_2 to effect rapid hardening. The invention provides for a tube to be rammed up with the core which is easily withdrawn after the core has been cured by passing the CO_2 through it.

News in Brief

A NEW PATTERN STORE is to be erected at Merchiston Foundry, Falkirk, at an estimated cost of £1,100.

THE EXTENSION to the factory premises in New Lane, Leeds, of Joshua Hindle & Sons, Limited, valve manufacturers, is planned to come into operation this month.

AN APOLOGY is offered to Ashmore, Benson, Pease & Company for printing in the JOURNAL last week that they charge 3s. a week, instead of 3d., to those using their ablution centre.

A SUBSIDIARY of Guest, Keen & Nettlefolds, Limited, W. H. Moore & Sons, Limited, of Bordesley, Birmingham, is to be merged with the United Wire Works (Birmingham), Limited, from August 3.

OBTAINED by the Brush Group, Limited, in the face of keen competition, especially from Switzerland, an order for the supply of electrical supply equipment from the Liberian Government is worth over $250,000.

THE No. 1 FURNACE at the works of the Consett Iron Company, Limited, Consett (Co. Durham), which has been in continuous operation for seven years, is to be relined. The furnace has produced over 1,400,000 tons of iron since 1950.

A NEW BLOCK OF OFFICES, warehouses, and garages —costing approximately £750,000—erected in Neville Road, East Bowling, for the Bradford engineering firm, Hepworth & Grandage, Limited, was officially opened on July 17.

WILLIAM FOSTER & COMPANY, LIMITED, of Lincoln, have secured an order for pumping installations for a new naval dock at Bombay. The company is also to provide six 54-in. main pumps with other auxiliary units for the new Berkeley (Glos) atomic power station.

SPEAKING at last month's annual meeting of Aiton & Company, Limited, pipework specialists and ironfounders, of Derby, Wing-Commander J. M. Aiton, the chairman, said that since the formation of the business over 50 years ago, only £5,000 of new money had been added to the original £5,000 with which it was started.

A CONTRACT worth more than £250,000 has been placed with Henry Balfour & Company, Limited, engineers and ironfounders, Leven, by the Scottish Gas Board. The firm will make a block of the lastest type of tower purifier and erect it at the Granton Gasworks, Edinburgh. The plant will take about a year to complete.

NEW LABORATORIES of the National Coal Board's Mining Research Establishment at Isleworth were opened by Sir James Bowman, chairman of the board, on July 24. The completion of the laboratories marks the final stage in a programme of converting what was formerly a film studio into a research establishment.

TWENTY-TWO apprentices of the Austin Motor Company, Limited, left on July 26, for a tour of industrial Germany lasting 18 days. The youths will visit steel-rolling mills and the Mercédès-Benz plant at Stuttgart. The cost of the trip, which is the first of its kind from Longbridge, is being partly borne by the company.

THE COUNCIL of the Institution of Chemical Engineers has decided to support the Chemical and Petroleum Engineering Exhibition, which will be held at Olympia, London, in June 1958, by organizing a symposium on the subject "The Organization of Chemical-engineering Projects." The symposium will take place at Olympia at the time of the exhibition.

PLANS FOR THE BUILDING of a new 550-ft. fitting-out quay at the Southwick yard of Austin & Pickersgill, Limited, shipbuilders, of Sunderland, have been approved by the River Wear Commissioners. The new quay is part of a modernization scheme, estimated to cost more than £1,000,000, which will enable the company to build vessels up to 23,000 tons.

TAYLOR TOOLS & SUPPLIES, LIMITED, Vortex Works, Atlantic Street, Broadheath, Altrincham, Cheshire, announce that they have appointed the following as sales agents: H. Sumner, Limited, 45-47, Stour Street, Birmingham, 18; Mr. G. Clarke, 64, Beverley Road, Manchester, 14, and Power Tools & Accessories, Limited, 37, Sheen Road, Richmond, Surrey.

SOLARTRON ELECTRONIC GROUP, LIMITED, Surrey, and the Rheem Manufacturing Company, New York, USA, announce the joint setting up of Rheem-Solartron, Limited. It is a research and development company to work on radar-simulation projects and certain other electronic devices, including a multi-headed electronic reading machine for commercial applications.

BUSINESS DECLARED AS SHIPPED under the Export Credits Guarantee Department "commercial" cover in the second quarter of 1957 amounted to £119,400,000 millions, an increase of some £19,000,000 over the figure (£100,500,000) for the corresponding quarter of last year. It was however below the record figure of £143,500,000 in the previous quarter.

JOHN FOWLER & COMPANY (LEEDS), LIMITED, announces that, with effect from August 6, all sales of and correspondence relating to "Challenger" tractors will be centralized at Marshall/Fowler Sales, Britannia Works, Gainsborough (Lincs) (telephone: Gainsborough 2301). The service and spares departments of the company will continue to operate from Leeds.

FORTY GERMAN apprentice fitters recently took the French apprenticeship examination, and 40 French apprentice fitters took the German apprenticeship examination. The training levels of the two countries were shown to be comparable, but in the tests on speed of fitting and degree of precision, the French were a short way ahead. All the French lads passed, but three of the Germans failed.

CHARRINGTON, GARDNER, LOCKET & COMPANY, LIMITED, Tower House, Trinity Square, London, E.C.3, have begun construction of a new fuel-oil terminal at Poplar. The installation will initially have a capacity of 18,000 tons and cost £400,000. Work on the ten-acre site is already well advanced, and the terminal will be operating in time to cope with the peak demand for fuel oil this winter.

FIRTH-VICKERS STAINLESS STEELS LIMITED, of Sheffield, at the Society of British Aircraft Constructors Show, to be held at Farnborough, from September 2 to 8, will feature Staybrite steels in a variety of applications, including centri-sand, centri-die, and static sand castings, together with a number of intricate aeronautical components manufactured by a highly developed form of the "lost-wax" process of casting.

A PORTUGUESE SHIPPING COMPANY, Nacional de Navegaçao, has placed an order with Swan, Hunter, & Wigham Richardson, Limited, Wallsend, for a 20,000 gross tons liner. Steam-turbine propelling machinery to give speed of 21 knots will be supplied by the Parsons Marine Turbine Company, Limited, Wallsend. This

News in Brief

contract, worth over £4,000,000, is the first important Portuguese ship order to be placed with a British yard for some years.

A COMMITTEE OF ENQUIRY into precautions against anthrax has been set up by the Minister of Labour and National Service. Interested parties desiring to submit evidence should write to Mrs. V. D. Crane, secretary of the committee, at the Ministry at 19 St. James's Square, London, S.W.1. When the last enquiry was held during the 1914-18 war, straw rope came in for consideration. Since that time the pattern of industry and trade has changed and it is deemed that changes in legislation are due.

THE NORTHERN IRELAND DEVELOPMENT COUNCIL announces that work is to begin on a new factory which the Ministry of Commerce is to build and let to Lee Guinness, Limited, precision engineers and instrument manufacturers. The factory, which will be located on a site near the company's existing factory at Newtownards, Co. Down, will produce automatic-control gear, and it is expected that when in full operation between 400 and 500 workers will be employed.

INTERNATIONAL MEEHANITE METAL COMPANY, LIMITED, announce that recent additions to the list of Meehanite licensees include Crossley Bros., Limited (Manchester); Société d'Electricite et de Mecanique (Ghent, Belgium); Moorwoods, Limited (Sheffield); Potthoff & Flume G.m.b.H. (Lunen, Germany); Halberg Maschinenbau & Giesserei G.m.b.H. (Ludwigshafen, Germany); Buderus'sche Eisenwerke (Wetzlar, Germany); Argus Foundry, Limited (Glasgow); Porringer & Schindler G.m.b.H. (Zweibrucken, Germany); Nuovo Pignone S.p.A. (Florence, Italy); and Sabiem Fonderie Parenti (Bologna, Italy).

DESIGNED AND BUILT BY Ransomes & Rapier, Limited, what is claimed to be the world's largest walking dragline, weighing 1,675 tons and equipped with a 282-ft. long tubular-steel jib, has commenced work at an open-cast ironstone-quarry near Stamford, operated by the ore-mining branch of the United Steel Companies, Limited. Taking 30-ton bites at the overburden, the W1400, as it is called, initially is expected to strip 20,000 tons of ironstone each week; the actual rate of stripping is dependent on the thickness of the over-burden, which at the Exton Park quarry will increase gradually to between 80 and 90 ft.

RIPLEY URBAN DISTRICT COUNCIL has placed two historic blast furnaces on its provisional list of local buildings worthy of preservation and the furnaces —at Morley Park Ironworks at Heage, Derbyshire— have been surveyed by representatives of the British Iron and Steel Federation. The two furnaces, believed to be among the oldest blast furnaces in the country, date from 1790 and 1812 respectively and were built by Francis Hurt, a Derbyshire ironmaster. They were used for the cold-blast method of smelting iron and fell into disuse in the 1870's. They were among the earliest furnaces in Britain to use coke in place of charcoal.

"FOUR BACK ROOMS," a film produced by the British Transport Commission, has been selected for screening at the annual meeting of the British Association for the Advancement of Science in Dublin this month. The film shows how research has assisted in the design of railway tracks by revealing metal fatigue; in the calming of the sea at harbour entrances by the fitting of underwater air jets, thus making docking easier; in discovering how silt in river beds can be traced and obviated; and how, by the use of an electrical instrument, changes in the metal structure of mechanical components of buses under service conditions can be measured.

SEDGLEY URBAN COUNCIL has refused planning permission for Mrs. L. Cartwright, of Jockey Works, Sedgley, to continue to use the premises as a non-ferrous foundry. The application had been referred to the county planning authority which recommended that permission be refused on the grounds that it is proposed to include the area as residential in the Development Plan. Sedgley Council had earlier sought to purchase the works compulsorily, and the owner first obtained an *ex parte* order and later opposed the Council in a High Court action before Mr. Justice Upjohn. The Judge granted Mrs. Cartwright an order restraining the Council from taking possession under the compulsory purchase order. Before it can purchase the works compulsorily the Council must now serve a further notice to treat.

SIR PETER ROBERTS, the Master Cutler, arrived back in this country by air on July 22 from Montreal, accompanied by Lady Roberts. During the course of his visit to the United States, Sir Peter presented a cabinet of cutlery, the gift of the Cutlers' Company, to President Eisenhower. He also had the honour of being taken on the floor of the Senate by a group of senators during a debate on the Civil Rights Bill. In a broadcast from Toronto, Sir Peter urged the new Canadian Conservative Government to establish a British import finance commission to encourage the purchase, by Canadian companies, of heavy machinery and steel for building from Britain. Sir Peter pointed out that the average British steel company was not in a position to grant the long-term credit facilities which many Canadian customers required.

HOLIDAY BONUSES of up to £47 have been earned by employees of Mavor & Coulson, Limited, founders and machinery manufacturers, Glasgow, for suggestions which have helped to improve the firm's output. The top award of £47 went to Mr. T. Parker, an employee at the East Kilbride factory, for a suggestion to substitute cast-iron bushes for phosphor-bronze bushes in the winding drums of hand-operated winches. A cheque for £19 10s. was paid to Mr. J. Chester in the Glasgow works for evolving a method of machining inner gland nuts which gave an output of 14 instead of 12 from each chill casting. Mr. C. Slevin, of "M" Dept., earned £17 10s. for a suggestion that enabled more tee-bars to be cut from set lengths of material. Four boys and two girls earned 10s. each for suggestions to improve the liaison between the office and the works departments.

AT A MEETING of the Birmingham Chamber of Commerce last month, Mr. R. S. Kinsey, of the Export Credits Guarantee Department of the Board of Trade, told members that British businessmen should go "flat out" to capture some of the dollar aid now going to Far Eastern countries. Through the International Co-Operation Administration, America was making millions of dollars available to countries like Korea, Formosa, Vietnam, the Philippines and Siam, he said. Business financed in this way was open to world-wide tender; items were for cash and payment was in dollars, yet very little attention was being paid by the British businessman to the market in this area. He added that there was a tendency to regard the area as part of the American sphere of influence but these countries were anxious to vary their trading and they would welcome the opportunity to buy British products. In the main, British prices compared very favourably with others, though delivery was not as good as that from some parts of America.

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Pig-iron and Steel Production

Statistical Summary of May Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table I summarizes activities during the past four months. Table II gives production of steel ingots and castings in May and Table III. weekly average production of finished steel. Table IV gives the production of pig-iron and ferro-alloys in May, and furnaces in blast. (All figures weekly averages in thousands of tons.)

TABLE I.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production.*

Period.	B.o.T. Price Index, 1938 = 100.			Iron-ore output.	Imptd. ore used.	Coke to blast-furnaces.	Pig-iron, ferro-alloys prod.	Scrap used in steel prod.	Steel (incl. alloy).			
	I. & S.	Coal.	Basic materials excl. fuel[1]						Imports.[2]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks.[3]
1957—Feb. ..	317	476	554	347	281	266	268	234	17	432	341	1,347
Mch. ..	317	477	552	343	298	270	277	228	17	431	336	1,358
April	317	477	555	329	301	273	277	223	12	430	317	1,416
May ..	318	467	554	341	310	272	284	234	13	443	—	1,437

TABLE II.—*Weekly Average Production of Steel Ingots and Casting in May.* 1957

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby, Leics., Notts., Northants and Essex ..	—	5.0	13.8 (basic)	2.7	0.1	20.2	1.4	21.6
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire	2.4	33.7	—	2.5	0.4	37.4	1.6	39.0
Yorkshire (excl. N.E. Coast and Sheffield) ..								
Lincolnshire	—	46.4	—	—	0.1	46.3	0.2	46.5
North-East Coast	0.7	85.9	—	1.6	0.4	86.5	2.1	88.6
Scotland	3.2	48.3	—	2.6	0.4	52.3	2.2	54.5
Staffs., Shrops., Worcs. and Warwick	—	20.8	—	1.3	0.7	20.8	2.0	22.8
S. Wales and Monmouthshire	4.9	89.2	7.6 (basic)	1.1	0.2	102.3	0.7	103.0
Sheffield (incl. small quantity in Manchester) ..	9.8	36.7	—	12.7	0.5	57.5	2.2	59.7
North-West Coast	0.1	1.7	5.0 (acid)	0.6	0.1	7.4	0.1	7.5
Total	21.1	367.7	26.4	25.1	2.9	430.7	12.5	443.2

TABLE III.—*Production of New Non-alloy and Alloy Finished Steel.*

Product.	1955.	1956.	1956.	1957.	
			April.	March.	April.
Non-alloy steel:					
Ingots, blooms, billets and slabs[5]	4.9	4.7	5.5	5.4	4.5
Heavy rails ..	9.4	9.7	11.9	11.6	11.2
Sleepers, etc. ..	2.0	1.8	2.0	2.3	2.6
Plates, ⅜ in. to ¼ in.	26.4	30.3	32.6	37.2	33.9
Other heavy prod.	47.8	50.3	55.0	55.4	55.3
Ferro-concrete bars and rods ..	7.0	7.8	8.4	8.5	9.0
Wire rods	22.2	22.9	25.9	22.4	20.6
Arches, etc. ..	9.6	10.1	10.6	11.6	11.6
Other light sections	36.8	41.4	42.5	43.6	37.6
Bright steel bars ..	7.8	8.0	8.6	7.1	6.7
Hot-rolled strip ..	24.1	24.5	25.9	25.2	22.9
Cold-rolled strip ..	8.1	7.5	8.3	7.0	6.5
Sheets, incl. coated					
(i) Hot rolled ..	16.6	15.0	17.4	12.5	11.9
(ii) Cold reduced	26.1	24.8	27.2	28.8	27.0
Tin and terneplate	15.6	15.9	16.2	19.4	21.3
Blackplate ..	1.4	1.3	1.4	1.0	0.9
Steel tubes, pipes	22.9	26.2	25.7	27.9	25.8
Tube and pipe fittings	0.4	0.5	0.6	0.5	0.5
Tyres, wheels, axles	4.8	4.6	5.5	4.9	4.5
Forgings (excl. drop forgings) ..	2.5	3.0	2.9	3.4	3.1
Steel castings ..	4.2	4.5	4.5	4.4	4.1
Tool and magnet steel	0.3	0.3	0.3	0.4	0.3
Total	320.6	335.0	361.3	361.9	341.4
Alloy steel	15.8	17.3	18.3	17.3	16.2
Total deliveries from U.K. prod.[6] ..	336.4	352.3	379.6	379.2	357.6
Add : Imported finished steel ..	18.9	19.5	29.7	10.2	7.6
	355.3	371.8	409.3	389.4	365.2
Deduct: Intra-industry conversion[7] ..	50.9	55.2	60.2	54.7	49.5
Total new material ..	304.4	316.6	349.1	334.7	315.7

TABLE IV.—*Production of Pig-iron and Ferro-alloys during May* 1957

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex	26	—	30.1	19.9	0.5	—	50.5
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire ..	7	—	20.9	—	—	1.0	21.9
Yorkshire (excl. N.E. Coast and Sheffield) ..							
Lincolnshire ..	10	—	42.0	—	—	—	42.0
North-East Coast	21	4.7	55.7	—	—	0.9	61.3
Scotland	9	0.9	15.4	1.5	—	—	17.8
Staffs., Shrops., Worcs., and Warwick ..	7	—	11.1	1.7	—	—	12.8
S. Wales and Monmouthshire	11	4.9	49.6	—	—	—	54.5
Sheffield	1	—	2.0	—	—	—	2.0
North-West Coast	9	20.1[2]	—	0.3	—	0.3	20.7
Total ..	101	30.6	226.8	23.4	0.5	2.2	283.5
April, 1957 ..	99	30.3	221.7	23.6	0.4	1.4	277.4
May, 1956[4] ..	100	29.5	188.0	24.5	0.8	3.7	246.5

[1] Used in non-food manufacturing industry.
[2] Weekly average of calendar month.
[3] Stocks, mainly ingots and semi-finished, at the end of the years and months shown.
[4] Five weeks, all tables.
[5] Other than for conversion into any other form of finished steel listed.
[6] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
[7] Material for conversion into other products also listed in this table.

Facts from the record
of Goodyear conveyor belting

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Stacker exceeds British Standards Grade "A" in all requirements of fabric and rubber and may be used at temperatures up to 200 deg. F.
Made with the highest grade friction stock between plies for maximum flex-life.
Has the toughest cover obtainable, with the highest possible resistance to cutting, gouging and abrasion.
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Stacker is available in 28, 32, 36, 42 and 48 oz. duck weights, from 3 to 9 plies and in a full range of widths, lengths and cover gauges.

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For operations where extreme resistance to oil is necessary. Especially suitable for carrying oil-sprayed co... meat, fish or food where an...

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STYLE HRS

APPLICATIONS

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The carcass, cover and skim-coating between plies give all the heavy-duty characteristics of a Grade "A"...

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Raw Material Markets

Iron and Steel

Increases in the maximum prices of iron and steel products came into effect on Monday. The increases average about 7½ per cent. over the whole range of products, but are slightly higher in some instances and lower in others. The Iron and Steel Board pointed out that the increases derived in the main from the successive increased costs with which the industry had been faced. In the board's view it would not be possible for the industry to carry the heavy burden represented by these increased costs and at the same time support the major investment programme for modernization and expansion. This was especially true as the board had thought it necessary to increase the allowance for depreciation and obsolesence of fixed assets in the light of technical changes which had occurred or were in prospect. Subject to that point, in the assessment of the new prices producers' margins had continued to be determined on the principles adopted after the review carried out last year.

In its announcement, made on Thursday of last week, the Iron and Steel Board stated that certain changes would be made in the price structures. The price of pig-iron would be higher in coastal and certain other areas than in the home ore-producing areas. Other changes included higher zone extras for billets and an allowance off the price of strip mill sheets and coil where these were delivered within the vicinity of the producing works.

The board emphasized that UK prices for products of open-hearth quality would in general still be below those for products of similar quality in the other main steel-producing countries, and substantially so in the case of plates, sheets, and tinplate. In Germany, however, certain light-rolled products would be cheaper than in the UK.

In some European countries the prices of products of basic Bessemer quality steel would be somewhat lower than those for open-hearth quality made here. Basic Bessemer steel, although of lower quality than open-hearth steel, was considered suitable for a range of products on the Continent and, the board stated, with a few exceptions these products were not made from Bessemer steel in the UK or in the USA.

An increase from last Monday in the prices of iron and steel scrap, averaging £1 a ton, was simultaneously announced by the Ministry of Power. It also takes account of the increases in railway freight rates which come into force to-day (Thursday).

Holidays are influencing deliveries of raw materials and production of castings. Major repairs to plant and cupolas are being carried out at many foundries, and deliveries of raw materials have been suspended entirely. A few of the engineering foundries supplying castings to the motor-car industry have arranged to take in deliveries. This indicates their need for all available supplies (of low-phosphorus irons in particular) to fulfil their improved order-books, as they are anxious to have good supplies of pig-iron on hand when they restart. Most of the other foundries, however, have adequate tonnages in stock.

The supply of hematite pig-iron is more than sufficient to meet present demands. This no doubt accounts for the decision to release supplies for export. Apart from the steelworks, which continue to take up all available tonnages, the engineering and speciality foundries continue to be the biggest consumers of pig-iron in the hematite and low-phosphorus irons and, to a lesser extent, in the refined grades. High-phosphorus pig-iron is plentiful and, with only moderate demands from the foundries using this grade and the suspensions in deliveries due to holidays, the furnaces are increasing their stocks. Overseas orders are, however, taking some of the tonnages at furnaces.

A good demand continues for the heavier and better grades of cast-iron and machinery scrap. Foundry coke is being received in adequate tonnages, apart from some of the Welsh grades which continue scarce.

Most of the re-rollers are taking their annual holiday this month. Meanwhile, they are fairly well off for work for their products of small bars, light sections, strip, etc. Most of them are well provided with steel semis and, apart from the supplies of foreign steel which many of them have in stock, home steelworks continue to send forward good deliveries. Arisings of defectives and crops are now more difficult to dispose of as adequate supplies of prime-quality material are available.

Non-ferrous Metals

How healthy the supply position is for copper was demonstrated this week. On the Northern Rhodesian Copperbelt the rockbreakers have been on strike and all the Copperbelt mines closed down. In front of this news, copper in London was firm at a higher level. However, second thoughts and the fact that US trade circles took the news calmly soon sent the price tumbling. The American view was that unless the strike was prolonged for a month or more there would be little, if any, market reaction. On Tuesday, however, it was announced that the five-day stoppage on the Copperbelt had ended with the acceptance of a Government commission of inquiry.

From Chile comes the news that production during the first four months of this year showed an increase of over 9 per cent. on the comparable period in 1956. But prices slumped too much to enable the higher output offset the loss in revenue. The Chilean Ministry of Finance has announced that copper, brass and bronze scrap are not to be exported for the rest of the year.

Tin continues to drift downwards despite a steady undertone. Consumer interest has tailed off and with the better labour situation in the East the London price has eased. In the States, consumer interest is also at a low ebb, but the strike in Pahang is being watched with interest. The US price is now down below 96 cents a pound. Tin stocks in London at the end of last week improved further to 2,861 tons.

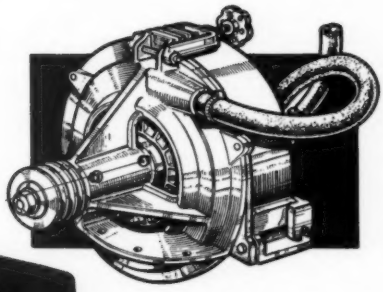
Lead prices moved upwards at the end of last week on the news that the metal was on the latest list of commodities authorized for acquisition by the stockpile. The report gave no details as to tonnages. This week the market has gone easier, activity being small. Zinc, like lead, firmed up on the news of its inclusion in the latest stockpile list, but there was no revival of consumer demand to hold the higher quotation and the price slipped back.

Bynea Holding Company Formed

The issued share capital of Bynea Steel Works, Limited, recently acquired from the Iron and Steel Holding and Realization Agency, is to be held by Bynea Holdings, Limited, a new company formed by John S. Tregoning & Company, Limited, Ductile Steels, Limited, and Robert Benson, Lonsdale & Company, Limited. The directors are:—Mr. P. O. Williams (chairman), Mr. Leonard Tregoning, Mr. F. J. Read, Mr. R. Sidaway and Mr. L. L. Wicken. Mr. Sidaway is chairman and managing director and Mr. Wicken a director and secretary of Ductile Steels.

Shot Blast Equipment

This A-S-L Turbine is the most modern Shot Blasting Unit available. The bi-phase air injection system enables shot to be projected at greater speeds using lower power with fewer replacements. The economies effected in spare parts alone are very substantial.



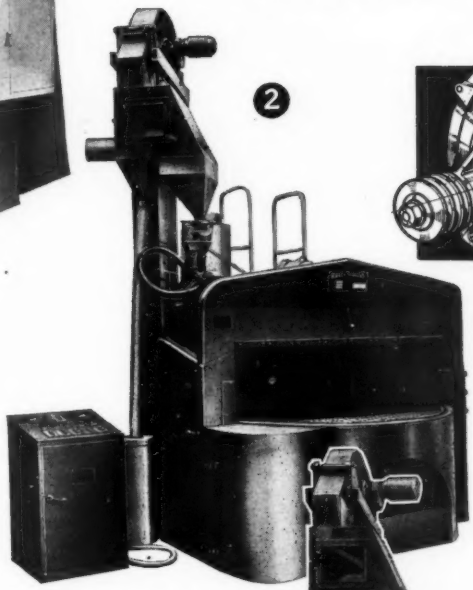
Baker Perkins High Speed Bi-Phase A-S-L Turbine, British Patent, No. 510681.

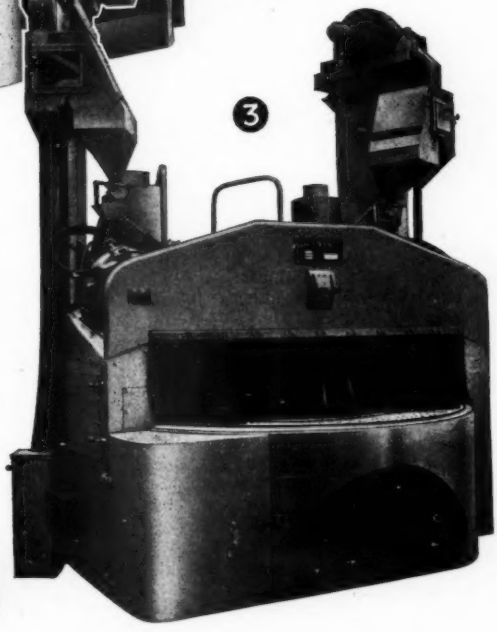
These machines do not require pits or special foundations.

1 ROTARY BARREL

2 CADET

3 MEDIUM





Our standard range of Rotating Barrel and Table Shot Blast Machines is capable of handling a wide range of Foundry products. Both types are semi-automatic, the rotating barrels being equipped with skip hoist loading gear and frontal discharge mechanism. These modern highly efficient machines are in use in Foundries all over the world, and are built to the high standards of design, materials and workmanship characteristic of all Baker Perkins' machines.

BAKER PERKINS LIMITED
ENGINEERS
WESTWOOD WORKS · PETERBOROUGH

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

July 31, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

Scotch Iron.—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S. 1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £53 5s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 8d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 8d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3¾d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 22s. 6d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £82 12s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £33 1s. 6d.; tested, 0.08 to 0.33 per cent. C, £34 1s. 6d.; hard (0.41 to 0.60 per cent. C), £35 3s. 0d.; silico-manganese, £44 2s. 6d.; free-cutting, £37 5s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £41 7s. 0d.; silico-manganese, £44 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.33 per cent. C, £38 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 18s. 6d.; acid, up to 0.25 per cent. C, £43 10s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £42 12s. 0d.; boiler plates (N.-E. Coast), £45 2s. 0d.; floor plates (N.-E. Coast), £44 1s. 0d.; angles, N.-E. Coast, £40 6s. 6d.; joists, N.-E. Coast, £40 2s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested soft basic, £40 8s. 0d.; flats, 5 in. wide and under, £40 8s. 0d.; hoop and strip, coils, £40 10s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £45 16s. 0d.; black sheets (hand mill), 24 g., £59 4s. 0d.; galvanized corrugated sheets, 24 g., £68 17s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £69 9s. 6d., nickel-chrome, £100 12s. 6d.; nickel-chrome-molybdenum, £112 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £213 0s. 0d. to £213 5s. 0d.; three months, £216 0s. 0d. to £216 5s. 0d.; settlement, £213 5s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 1d. per lb.; rods, 249s. 9d. per cwt. basis; 20 s.w.g., 283s. 0d. per cwt.

Tin.—Cash, £746 0s. 0d. to £746 10s. 0d.; three months, £743 10s. 0d. to £744 10s. 0d.; settlement, £746 10s. 0d.

Lead (Refined Pig).—First half August, £91 5s. 0d. to £91 7s. 6d.; first half November, £92 0s. 0d. to £92 5s. 0d.

Zinc.—First half August, £72 5s. 0d. to £72 15s. 0d.; first half November, £72 15s. 0d. to £73 0s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £108 10s. 0d.; rolled zinc (boiler plates), all English destinations, £106 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £90.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 8¾d. per lb.; rods, drawn, 2s. 11d.; sheets to 10 w.g., 183s. 9d. per cwt.; wire, 2s. 5¾d.; rolled metal, 183s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £153; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £198; HTB2 (38 tons), £211; HTB3 (48 tons), — .

Gunmetal.—BS1400, LG2 (85/5/5/5), — ; LG3 (86/7/5/2), £200; G1 (88/10/2/½), £268; (88/10/2/1), — .

Phosphor Bronze.—BS1400, PB1 (AID released), — per ton.

Phosphor Bronze Strip, etc.—Strip, 267s. 9d. per cwt.; sheets to 10 w.g., 287s. 0d. per cwt.; wire, 3s. 9¾d. per lb.; rods, 3s. 1¾d.; tubes, 3s. 2¼d.; chill cast bars: solids 3s. 1¾d., cored 3s. 2¾d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 8d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 0¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 11¾d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £87 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, — ; AB2, — .

* Average 68-70 per cent.